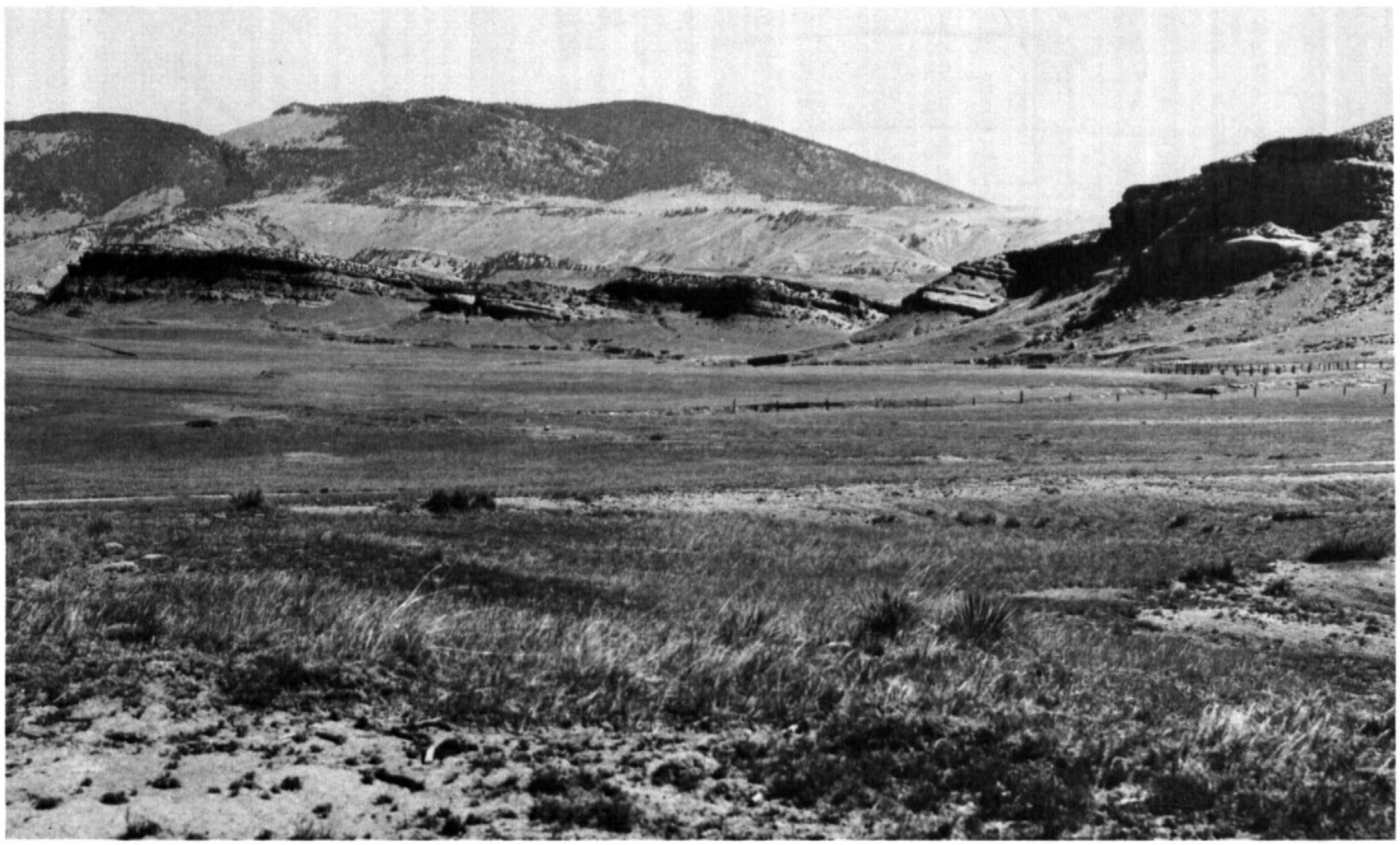
SOIL SURVEY OF

Johnson County, Wyoming
Southern Part



United States Department of Agriculture
Soil Conservation Service
In cooperation with
Wyoming Agricultural Experiment Station

Major fieldwork for this soil survey was done in the period 1962 to 1969. Soil names and descriptions were approved in 1971. Unless otherwise indicated, statements in the publication refer to the conditions in the county in 1968. This survey was made cooperatively by the Soil Conservation Service and the Wyoming Agricultural Experiment Station. It is part of the technical assistance furnished to the Powder River Conservation District.

Copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Johnson County, Wyoming, Southern Part, are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the survey area in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the range site in which the soil has been placed.

Individual colored maps that show the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units and the range sites.

Foresters and others can refer to the section "Management for Woodland," where a few soils of the survey area are grouped according to their suitability for trees.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Management for Wildlife."

Ranchers and others can find, under "Management for Range," groupings of the soils according to their suitability for range, and also the names of many of the plants that grow on each range site.

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain test data, estimates of soil properties, and information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in the survey area will be especially interested in the section "General Soil Map," where broad patterns of soils are described. They will also be interested in the information about the survey area given at the beginning of the publication and in the section "General Nature of the Area."

Cover: Area of Johnson County, Southern Part, locally called "Red Wall." The soils are Spearfish-Shale outcrop complex, steep.

Contents

Issued November 1975

SOIL SURVEY OF JOHNSON COUNTY, WYOMING, SOUTHERN PART

BY JAMES R. STEPHENS, JR., SOIL CONSERVATION SERVICE[1]

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE WYOMING AGRICULTURAL EXPERIMENT STATION

JOHNSON COUNTY, WYOMING, SOUTHERN PART, consists of privately owned, federally owned, and State owned land in the southern half of Johnson County (fig. 1). The survey area covers 1,198,067 acres. About 17,482 acres is irrigated, 4,472 acres is dryfarmed, 1,131,177 acres is rangeland, 35,152 acres is woodland, and 9,784 acres is woodland and range. Included within each are lands used for miscellaneous purposes.

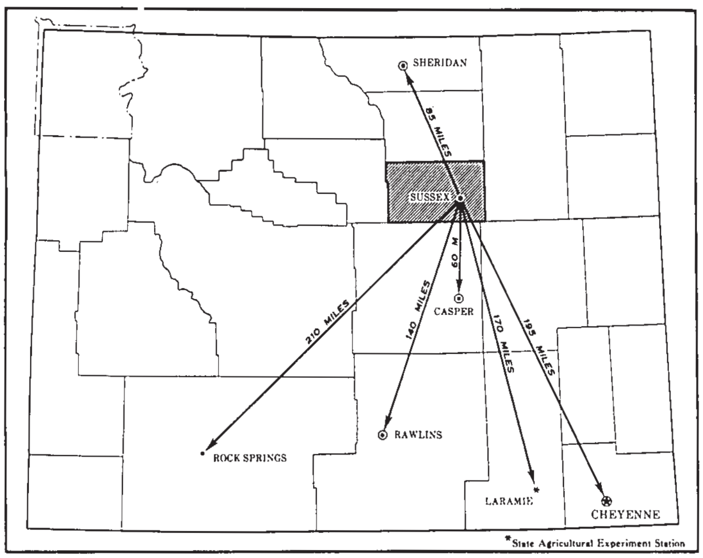


Figure 1.—**Location of Johnson County, Wyoming, Southern Part.**

The elevation of the survey area ranges from about 4,800 feet in the eastern part to more than 8,000 feet in the mountains along the western boundary. Some of the survey area consists of a part of the Big Horn Mountains and their foothills. The areas below the mountain front are dominated by rolling to steep uplands. These areas are dissected by the Powder River and its tributaries, such as the North Fork, Red Fork, Middle Fork, and South Fork of Powder River. These streams have carved long narrow valleys through the uplands. The valleys consist of gently sloping to moderately steep alluvial fans of various lengths and fairly narrow alluvial bottoms. The tributary streams run either north-easterly or southeasterly to the Middle Fork of Powder River. The Middle Fork of Powder River becomes the Powder River below the mouth of Salt Creek and runs in a northeasterly direction from the town of Sussex to the northern boundary of the survey area. The survey area is divided by a steep uplift known as the Pine Ridge, which runs from the north center of the survey area in a southeasterly direction to the southeastern corner.

The irrigated soils are confined to the narrow bottoms and alluvial fans along the main drainageways of Blue Creek and Beaver Creek and the Red Fork, North Fork, and Middle Fork of the Powder River as well as the Powder River. In many seasons there is a shortage of irrigation water late in summer. Water for irrigation is diverted from the tributaries of the Powder River to irrigate areas in the stream valleys. These irrigated areas are used mainly for hay and small grain as supplemental feed for livestock.

In the area of Ninemile Creek and Fourmile Creek, as well as in other areas in the eastern part of the survey area, many homesteads were taken up between 1915 and 1925. Considerable dryfarming was done in these areas until about 1930. Dryfarming in 1968 was limited to a few areas in the area of Ninemile Creek and Fourmile Creek and to a few areas along U.S. Highway No. 87, north of the town of Kaycee. Some of the homesteaders have indicated that rainfall in the 1920's was considerably higher than it is at present. In fact, during the 1920's a fair called the Nine Mile Fair was held in the area of Ninemile Creek and Fourmile Creek. Exhibits of garden produce and field crops at this fair were outstanding for the produce of dryfarming. The average yield per acre for dryfarmed small grain in the 1960's was somewhat less than 20 bushels per acre.

The upland areas adjacent to the irrigated stream valleys are used mainly for range. The mountain area above the foothills is used for summer range for livestock from ranch units that are headquartered below the mountain. In addition, there are sizable areas on the

[1] Others who contributed to the soil survey are PAUL J. LUPCHO, A. R. SHINEMAN, and KURT W. WEBBER. ARVAD J. CLINE and CLARENCE J. FOWKES assisted in the field correlation. All are soil scientists with the Soil Conservation Service or are soil scientists formerly on the staff of the Soil Conservation Service.

mountains and on the faces of the mountains that are used for woodland. The trees are harvested and, in most places, hauled off the mountain by sawmill operators.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Johnson County, Southern Part, where they are located, and how they can be used. The soil scientists went into the survey area knowing they were likely to find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes; the size and speed of streams; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Barnum and Limon, for example, are the names of two soil series. All the soils in the United States that have the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such differences, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Limon silty clay, saline, 0 to 6 percent slopes, is one of several phases within the Limon series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that help in drawing borders accurately. The soil map at the back of this publication was prepared from aerial photographs.

In the southern part of Johnson County, the availability of irrigation water and the use of dryfarming practices have influenced the mapping of soils. Soils that are in irrigated areas have been mapped within narrower slope ranges than soils of the dryfarmed areas or soils of the range areas. For example, some irrigated soils have been mapped as having 0 to 3 percent slopes, 3 to 6 percent slopes, and 6 to 10 percent slopes, and dryfarmed soils have been mapped as having 0 to 6 percent slopes and 6 to 20 percent slopes. The symbol used to identify the mapping unit indicates the intensity. The first letter, always a capital, is the initial one of the soil name. The next letter is a capital if the mapping unit is one of the low-intensity survey; it is a small letter if the mapping unit is one of the high-intensity survey. The last letter, a capital A, B, C, D, E, or F, indicates the slope range. Most symbols that do not have a slope letter are those of soils and land types that have a considerable range of slope, but some are those of nearly level soils.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series or of different phases within one series. Two such kinds of mapping units are shown on the soil map of this survey area: soil complexes and soil associations.

A soil complex consists of areas of two or more soils, so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the pattern and relative proportions are about the same in all areas. Generally, the name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Lohsman-Orella complex, hilly, is an example.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one unit because the time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils, but the soils can differ greatly one from another. The name of an association consists of the names of the dominant soils, joined by a hyphen. Barnum-Redbank association is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable that it has not been classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Rock land is a land type in this survey area.

While a soil survey is in progress, soil scientists take soil samples needed for laboratory measurements and for engineering tests. Laboratory data from the same kind of soil in other places are also assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kind of soil. Yields under defined management are estimated for all the soils.

Soil scientists observe how soils behave when used as a growing place for native and cultivated plants and as material for structures, foundation for structures, or covering for structures. They relate this behavior to properties of the soils. For example, they observe that filter fields for onsite disposal of sewage fail on a given kind of soil, and they relate this to the slow permeability of

the soil or a high water table. They see that streets, road pavements, and foundations for houses are cracked on a named kind of soil, and they relate this to the high shrink-swell potential of the soil material. Thus, they use observation and knowledge of soil properties, together with available research data, to predict limitations or suitability of soils for present and potential uses.

After data have been collected and tested for the key, or benchmark, soils in a survey area, the soil scientists set up trial groups of soils. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others. They then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under current methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in the survey area. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association can occur in another, but in a different pattern.

A map that shows soil associations is useful to people who want a general idea of the soils in a survey area, who want to compare different parts of a survey area, or who want to know the location of large tracts that are suitable for a certain kind of land use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field or for selecting the exact location of a road, building, or other structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect their management.

The soil associations in this survey have been grouped into three general kinds of landscapes for broad interpretative purposes. Each of the broad groups and the soil associations in each group are described in the following pages. The terms for texture used in the title for several of the associations apply to texture of the surface layer. For example, in the title of association 1, the words "sandy loams, fine sandy loams, loams, and silt loams" refer to the texture of the surface layer.

The soil associations in Johnson County, Southern Part, are described in the pages that follow.

Nearly Level to Moderately Steep Soils on Flood Plains and Alluvial Fans

The soils of the flood plains and alluvial fans are deep, nearly level to moderately steep, and well drained. They range from sandy loam to clay loam. They formed in alluvium in areas along the major streams.

Elevations of these soils range from about 4,500 to 5,500 feet. The average annual precipitation is 10 to 14 inches, the average annual soil temperature is 49° to 51° F., and the frost-free season is 100 to 120 days. The soils are used mainly for range; for irrigated hay, pasture, and small grain; and as wildlife habitat.

Two soil associations are on flood plains and alluvial fans. They make up about 7 percent of the survey area.

1. Stoneham-Haverson-Glenberg association

Deep sandy loams, fine sandy loams, loams, and silt loams

This association consists of nearly level soils on flood plains and nearly level to moderately steep soils on alluvial fans. The landscape is made up of stream bottoms that are dissected by meandering stream channels and of alluvial fans that reach from the bottoms to adjacent uplands. The association extends from Alkali Creek, west of Kaycee, down the Middle Fork of Powder River to Sussex, and north along Powder River to the boundary of the survey area.

This association makes up about 5 percent of the survey area. About 30 percent of it is Stoneham soils, 25 percent is Haverson soils, and 15 percent is Glenberg soils. The remaining 30 percent is Bankard, Kim, Lohmiller, Limon, Wyarno, and Zigweid soils and small areas of wet, saline soils.

The Stoneham soils are nearly level to moderately steep and occupy alluvial fans above the bottoms. They have a surface layer of light brownish-gray sandy loam or loam, a subsoil of dark yellowish-brown or light olive-brown clay loam, and a substratum of light yellowish-brown clay loam or loam that reaches to a depth of 60 inches or more. The Haverson soils are nearly level and occupy flood plains. They have a surface layer of light brownish-gray loam, silt loam, or clay loam. This is underlain by light brownish-gray loam that is stratified with clay loam and sandy loam and reaches to a depth of 60 inches or more. The Glenberg soils are nearly level and occupy flood plains that in most places are adjacent to stream channels. They have a surface layer of light olive-gray fine sandy loam and sandy loam. This is underlain by light yellowish-brown, pale-olive, and light olive-brown sandy loam that is stratified with loam, loamy sand, and sand and reaches to a depth of 60 inches or more.

The soils of this association are used for irrigated hay, grain, and pasture and for range. They are well suited to irrigated crops if land smoothing or leveling is practiced and if proper management of water and of pasture and hay is used. These soils have few limitations for hay, pasture, and small grain if they are irrigated. The Stoneham soils are suitable for community development and low industrial buildings. In some areas the use of Haverson and Glenberg soils is limited by a fluctuating water table and by occasional flooding.

2. Connerton-Barnum-Redbank association

Deep fine sandy loams, very fine sandy loams, loams, clay loams, and silt loams

This association consists of nearly level to moderately steep soils on alluvial fans and nearly level soils on flood plains. The landscape is made up of stream bottoms that are dissected by meandering stream channels and of alluvial fans that reach from the bottoms to the base of adjacent uplands. The association extends from Buffalo Creek and Beaver Creek in the Barnum area down

the Middle Fork of Powder River, taking in the Red Fork of Powder River, to Alkali Creek. It also is along the North Fork of Powder River from the Hat Ranch down to the Middle Fork of Powder River below Kaycee.

This association makes up about 2 percent of the survey area. About 40 percent of it is Connerton soils, 30 percent is Barnum soils, and 10 percent is Redbank soils. The remaining 20 percent is Glenberg, Haverson, Kim, La Fonda, and Rhoame soils and small areas of wet, saline soils.

The Connerton soils are nearly level to moderately steep and occupy alluvial fans. They have a surface layer of reddish-brown loam or silt loam. This layer is underlain by loam or clay loam that reaches to a depth of 60 inches or more. The Barnum soils are nearly level and occupy flood plains. They have a surface layer of reddish-brown very fine sandy loam or silt loam. This is underlain by reddish-brown loam that is stratified with fine sandy loam, clay loam, loamy sand, or sand and reaches to a depth of 60 inches or more. The Redbank soils are nearly level and are adjacent to stream channels on alluvial flood plains. They are reddish brown and have a surface layer of fine sandy loam. This is underlain by fine sandy loam that is stratified with lenses of loam and loamy sand and reaches to a depth of 60 inches or more.

The soils of this association are used for irrigated hay, pasture, and small grain and for range. They are suitable for these uses, but they are highly erodible. Irrigated crops can be successfully grown if ditches and laterals are properly located and if the management of water is better than average. The Connerton soils are suitable for community development if they are adequately managed. In some places the use of Barnum and Redbank soils is limited by a fluctuating water table and by periods of flooding.

Nearly Level to Steep Soils on Uplands

The soils and miscellaneous land types on uplands are nearly level to very steep and are well drained. They range from sandy loam to silty clay. They formed in residuum weathered from sandstone, shale, and siltstone in areas east of the Big Horn Mountains.

Elevations of these soils range from about 4,500 to 6,000 feet. The average annual precipitation is 10 to 14 inches, the average annual soil temperature is 50° to 53° F., and the frost-free season is 95 to 120 days. The soils are used mainly for range and wildlife habitat.

Five soil associations are on uplands. They make up 65 percent of the survey area.

3. Briggsdale-Renohill-Cushman association

Moderately deep, nearly level to moderately steep sandy loams, fine sandy loams, and clay loams

This association consists of moderately deep, nearly level to moderately steep soils on uplands. The landscape is made up of rolling uplands that are dissected by numerous drainageways and of small areas of gently sloping to sloping alluvial fans in valleys along intermittent streams. The association occurs in the area of Ninemile and Fourmile Creeks and in the area along the Dry Fork of Powder River. The bedrock is interbedded sandstone, siltstone, and shale; and many soils formed in material weathered from this bedrock.

This association makes up about 24 percent of the survey area. About 20 percent of it is Briggsdale soils, 15 percent is Renohill soils, and 10 percent is Cushman soils. The remaining 55 percent is Absted, Gaynor, Limon, Orella, Pugsley, Razor, Samsil, Shingle, Stoneham, and Worf soils and, on the eastern side of Powder River, some reddish-colored, sandy soils on high, rounded ridges.

The Briggsdale soils are on the lower hillsides. They have a surface layer of light brownish-gray or grayish-brown very fine sandy loam or sandy loam, a subsoil of dark yellowish-brown or olive clay loam or silty clay, and a substratum of silty clay loam that extends to soft shale at a depth of 20 to 40 inches. The Renohill soils are nearly level to moderately steep and are on hillsides. They are light brownish-gray, grayish-brown, light olive-brown, and light yellowish-brown clay loam throughout. Shale bedrock is at a depth of 20 to 40 inches. The Cushman soils are sloping or moderately steep and are on hillsides in areas that are underlain by sandstone. They have a surface layer of light brownish-gray fine sandy loam, a subsoil of yellowish-brown and brown clay loam, and a substratum of pale-olive sandy loam. Sandstone is at a depth of 20 to 40 inches.

The soils of this association are used for range and wildlife habitat. Desirable forage plants can be maintained if good range management practices are used. Areas of this association are accessible by roads and trails. They are suitable for community development if adequate sources of water can be developed. They are not close to present population centers.

4. Samsil-Shingle-Rock land association

Shallow, gently sloping to steep silty clays, loams, and clay loams, and steep and very steep Rock land

This association consists of shallow soils and Rock land (fig. 2). The landscape is made up of gently sloping to very steep ridges and narrow valleys that are dissected by numerous drainageways. The association is in the extreme northeastern corner of the survey area, near the mouth of Soldier Creek; on the eastern side of Powder River, below Sussex; and along the Pine Ridge. At the southern end of Pine Ridge, where elevations approach 6,000 feet, some of the soils formed under pine trees.

This association makes up about 12 percent of the survey area. About 30 percent of it is Samsil soils, 20 percent is Shingle soils, and about 15 percent is Rock land. The remaining 35 percent is Briggsdale, Cushman, Kim, Pugsley, Maysdorf, Terry, Schooner, Valent, and Worf soils.

The Samsil soils are sloping to steep and occupy hillsides and ridges. They are light olive-brown and light yellowish-brown silty clay that is underlain by shale at a depth of 8 to 20 inches. The Shingle soils are gently sloping to steep and occupy ridges, ridgecrests, and hillsides. They are light olive-brown or olive-yellow loam or clay loam that is underlain by shale at a depth of 8 to 20 inches. The Rock land is steep and very steep and is made up of 70 to 90 percent rock and 10 to 30 percent shallow and very shallow soils.

The soils of this association are used for range and wildlife habitat. In areas used for this purpose, forage

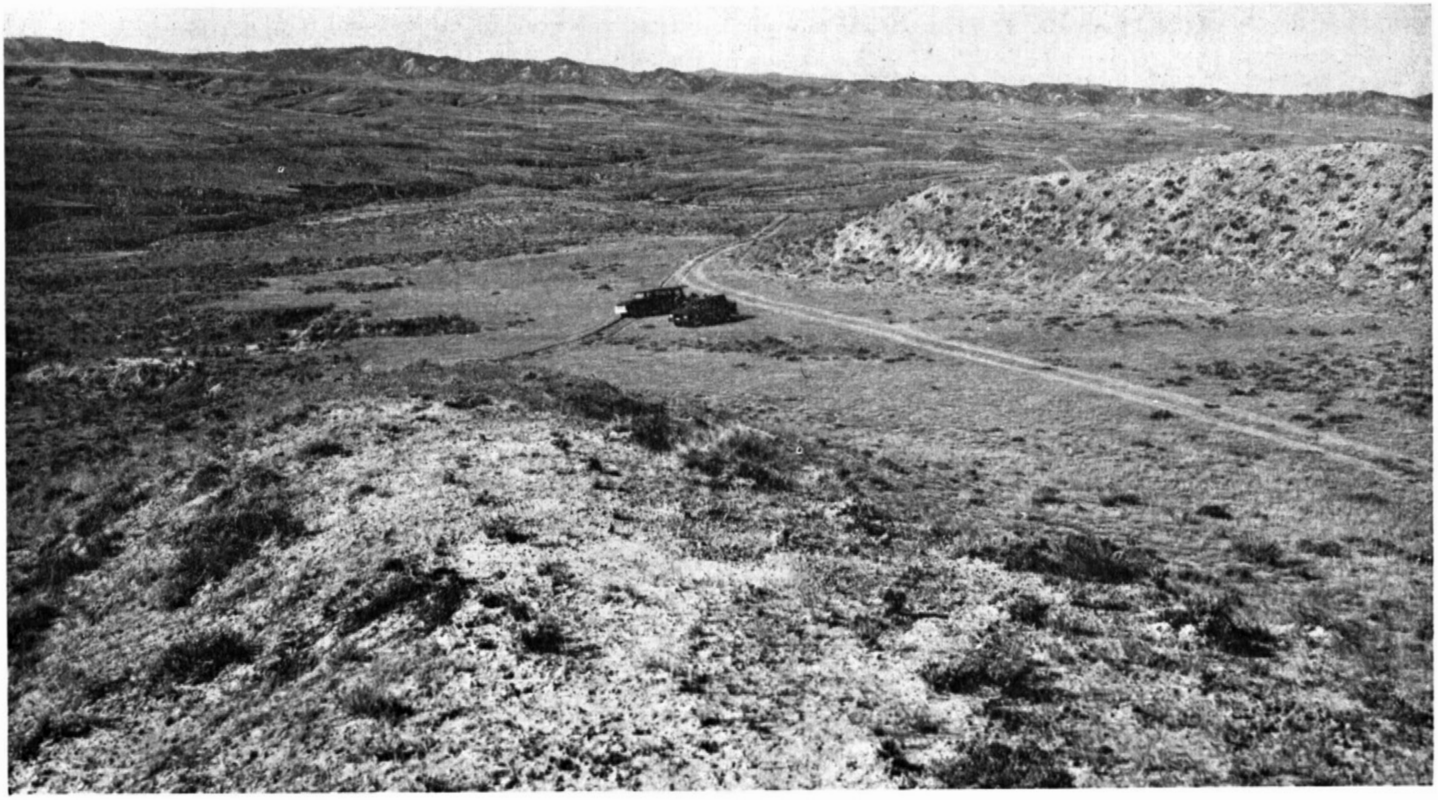


Figure 2.—Area of Samsil-Shingle-Rock land association, east of Sussex.

plants can be maintained if range management is better than average. Areas of this association are not easily accessible, although there are a few trails along some of the main ridges. The areas are not suitable for community or industrial development.

5. *Shale outcrop-Moret association*

Sloping to steep Shale outcrop and shallow, moderately steep or steep clay loams.

This association consists of shallow soils and Shale outcrop. The landscape is made up of steep ridges and moderately steep to steep hillsides that are dissected by many deep drainageways and broken by areas of sloping to steep, barren shale. The association occurs in the area of Murphy Creek and the South Fork of Powder River and in the drainage area of Alkali Creek. There are many bentonite pits in this area.

This association makes up about 13 percent of the survey area. About 15 percent of it is Shale outcrop, and about 10 percent is Moret soils. The remaining 75 percent is Harlan, Keyner, Kirtley, Rhoame, Samsil, Shirk, Travessilla, Wormser, and Zigweid soils.

The Moret soils are moderately steep or steep and occupy ridges and hillsides. They are light brownish-gray clay loam that is underlain by hard slaty shale at a depth of 10 to 20 inches. The Shale outcrop is sloping to steep and is scattered throughout the association. It is mostly outcrops of dark-gray shale that are intermingled with small areas of shallow or very shallow soils and deposits of bentonite.

The soils in this association are used for range and wildlife habitat. Desirable forage plants can be maintained if good range management practices are used. Areas of this association are accessible by trail from the main roads. They are not suitable for community or industrial development, because water suitable for these purposes is many miles away.

6. *Samsil-Gaynor-Shale outcrop association*

Moderately deep and shallow, sloping to steep silty clays and Shale outcrop

This association consists of moderately deep and shallow, sloping to steep soils. The landscape is made up of rounded ridges, steep-sided drainageways, and barren shale ridges. The largest area of this association is south of Kaycee. It is on the eastern side of the Interstate Highway No. 25 and runs to the southern boundary of the survey area. This area is 3 to 8 miles in width.

This association makes up about 8 percent of the survey area. About 30 percent of it is Samsil soils, 25 percent is Gaynor soils, and about 20 percent is Shale outcrop. The remaining 25 percent is Bone, Limon, Orella, Petrie, Razor, and Renohill soils.

The Samsil soils are sloping to steep and occupy hillsides and ridges. They are light olive-brown and light yellowish-brown silty clay that is underlain by shale at a depth of 8 to 20 inches. The Gaynor soils are sloping or moderately steep and occupy hillsides and ridges. They have a surface layer of light olive-brown silty clay. This is underlain by clay that extends to soft shale bed-

rock at a depth of 20 to 40 inches. The Shale outcrop is mostly dark-gray shale that is intermingled with small areas of shallow or very shallow soils and bentonite beds. It occupies barren ridges and drainageways or gullies.

The soils of this association are used for range and wildlife habitat. Desirable forage plants can be maintained if range management is better than average. Areas of this association are accessible by trail and by oilfield roads. They are not suitable for community or industrial development.

7. *Tassel-Cushman-Stoneham association*

Shallow to deep, sloping to steep sandy loams, fine sandy loams, and loams

This association consists of shallow to deep soils. The landscape is made up of sloping to steep ridges, hillsides, and alluvial fans, all of which are dissected by many, steep-sided, narrow drainageways. The association extends along Interstate Highway No. 25, north of Kaycee, and along the southern side of Pine Ridge, southeast of Kaycee. The North Fork Oil Field and Meadow Creek Oil Field are in this associatian.

This association makes up about 8 percent of the survey area. About 25 percent of it is Tassel soils, about 15 percent is Cushman soils, and about 15 percent is Stoneham soils. The remaining 45 percent is Fort Collins, Kim, Shingle, Terry, and Ulm soils and Rock outcrop.

The Tassel soils are moderately steep and steep and occupy ridges. They are light olive-brown and light yellowish-brown sandy loam that is underlain by sandstone at a depth of 8 to 20 inches. The Cushman soils are sloping or moderately steep and occupy hillsides. They have a surface layer of light brownish-gray fine sandy loam, a subsoil of yellowish-brown and brown clay loam, and a substratum of olive sandy loam that extends to sandstone at a depth of 20 to 40 inches. The Stoneham soils are nearly level to moderately steep and occupy alluvial fans. They have a surface layer of light brownish-gray or brown sandy loam or loam, a subsoil of dark yellowish-brown or light olive-brown clay loam, and a substratum of light yellowish-brown clay loam or loam that reaches to a depth of 60 inches or more.

The soils of this association are used for range and wildlife habitat. Desirable forage plants can be maintained if good range management practices are used. Areas of this association are accessible by a few roads and many trails. Topography is the limiting factor for future development.

Nearly Level to Steep Soils on High Terraces, Foothills, and Mountains

The soils and miscellaneous land types on high terraces, foothills, and mountains are nearly level to steep and are well drained to excessively drained. They range from very fine sandy loam to clay loam and have varying amounts of coarse fragments. They formed in alluvium and residuum weathered from limestone, sandstone, shale, and siltstone in areas on the mesa near Mayoworth and on the Big Horn Mountains.

Elevations of these soils range from about 5,000 to 9,000 feet. The average annual precipitation is 11 to 19 inches, the average annual soil temperature is 40° to 51° F., and the frost-free season is 60 to 110 days. The soils are used mainly for range, wildlife habitat, recreation, and woodland.

Three soil associations are on high terraces, foothills, and mountains. They make up about 28 percent of the survey area.

8. *Cragola-Wolf-Big Horn association*

Shallow to deep, nearly level to steep loams and very gravelly loams; on high terraces

This association consists of shallow to deep, nearly level to steep soils on high terraces and associated uplands. The landscape is made up of long, nearly level to gently sloping, planed terraces of varying widths that adjoin moderately steep and steep uplands that are underlain by gravel. The association is on the mesa near Mayoworth and in the drainageway of Crazy Woman Creek north of the mesa.

This association makes up about 3 percent of the survey area. About 35 percent of it is Cragola soils, 30 percent is Wolf soils, and 20 percent is Big Horn soils. The remaining 15 percent is Ascalon, Fort Collins, Kim, Otero, Petrie, Shingle, and Stoneham soils.

The Cragola soils are moderately steep and steep and occupy ridges and sides of terraces. They have a surface layer of light brownish-gray very gravelly loam. This is underlain by pale-brown and light yellowish-brown very gravelly clay loam that reaches to soft siltstone bedrock at a depth of 10 to 20 inches. The Wolf soils are nearly level to moderately steep and occupy planed terraces and uplands. They have a surface layer of grayish-brown loam, a subsoil of brown and light brownish-gray clay loam, and a substratum of white or light brownish-gray gravelly clay loam that reaches to a depth of 60 inches. The Big Horn soils are nearly level to gently sloping and occupy terraces. They have a surface layer of grayish-brown loam, a subsoil of grayish-brown or light brownish-gray clay or clay loam, and a substratum of light-gray or grayish-brown gravelly clay loam that reaches to a depth of 40 to 60 inches.

The soils of this association are used for range and wildlife habitat. Desirable forage plants can be maintained if good range management practices are used. Areas of this association are accessible by gravel roads. All but the soils on steeper terraces are suitable for community and industrial development. The soils on planed terraces are suitable for irrigated crops if water is developed. In many places this association is used as a source of gravel and sand.

9. *Sunup-Spearfish-Rock outcrop association*

Shallow, moderately steep and steep very fine sandy loams and channery clay loams and Rock outcrop; on foothills

This association consists of shallow, light brownish-gray or olive, channery soils and shallow, reddish-brown soils on foothills of the Big Horn Mountains (fig. 3). The landscape is made up of hilly and steep uplands on the flanks and on the broken foothills at the base of the Big

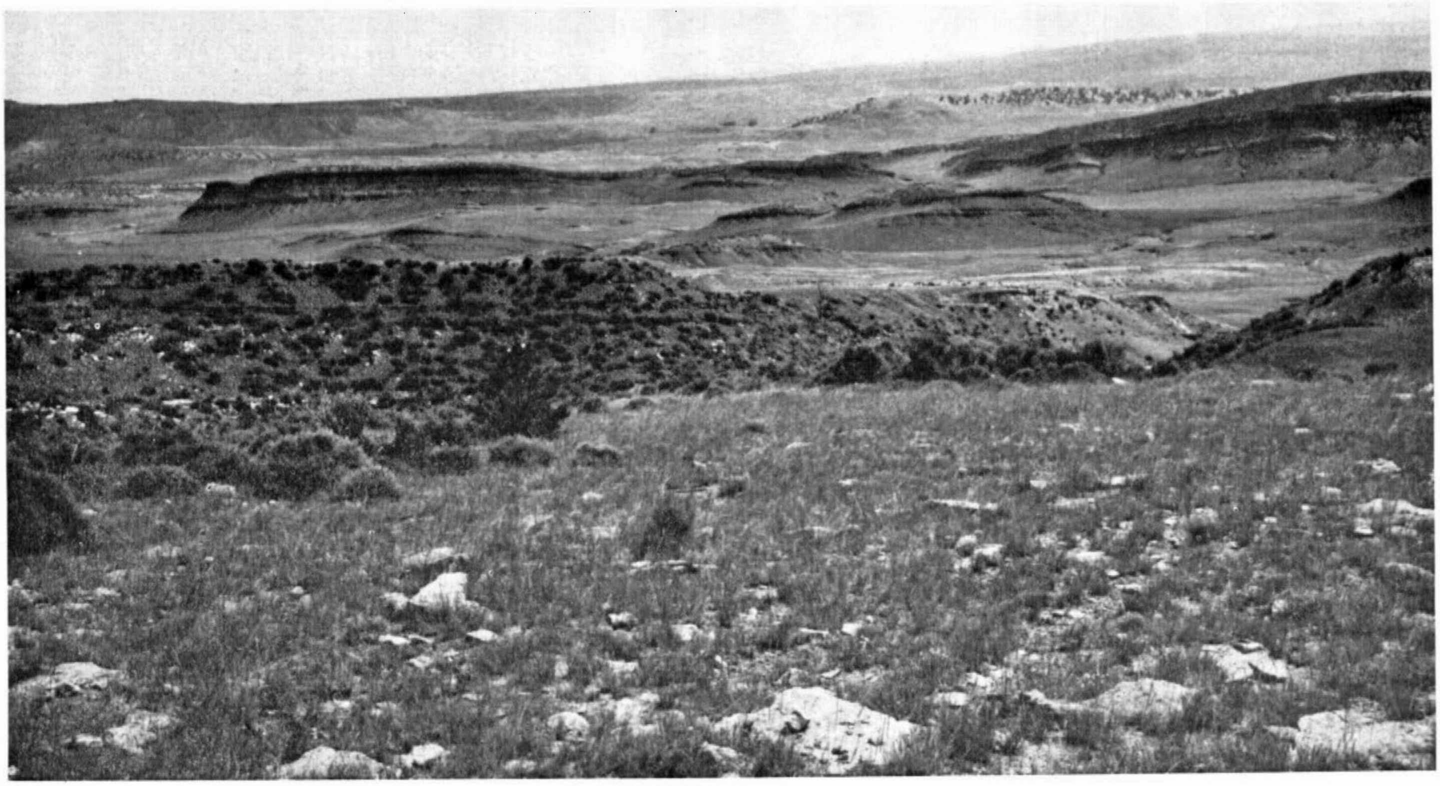


Figure 3.—Area of Sunup-Spearfish-Rock outcrop association west of Mayoworth. In foreground are Sunup soils; in background are Spearfish soils.

Horn Mountains. The association is in the red wall area, above Mayoworth and Barnum, and extends the full length of the survey area from north to south.

This association makes up about 10 percent of the survey area. About 40 percent of it is Sunup soils, 25 percent is Spearfish soils, and 20 percent is Rock outcrop. The remaining 15 percent is Bayerton, Carnero, Connerton, Harlan, La Fonda, Pokeman, Rekop, Simmont, and Tolman soils.

The Sunup soils are moderately steep and steep and occupy ridges and hillsides. They are light brownish-gray or olive channery clay loam that is underlain by hard bedrock at a depth of 10 to 20 inches. The Spearfish soils are moderately steep and steep and occupy the broken foot slopes on the red beds below Sunup soils. They have a surface layer of reddish-brown very fine sandy loam and a subsurface layer of red very fine sandy loam or channery loam that is underlain by red siltstone and sandstone at a depth of 8 to 20 inches. The Rock outcrop is hard sandstone, red siltstone, sandstone, and red shale, mostly in canyons that have nearly vertical walls.

The soils of this association are used for range, wildlife habitat, and recreation. Desirable forage plants can be maintained if range management is better than average. The reddish-brown soils and some of the bedrock are highly erodible. Areas of this association are accessible by trail and by one or two bladed, unimproved roads. The areas are not suitable for community or industrial development.

10. Nathrop-Starley-Woosley association

Moderately deep and shallow, sloping to steep loams, gravelly loams, and stony loams

This association consists of moderately deep and shallow soils in the mountains. The landscape is made up of sloping to steep ridges and hillsides that lead to narrow mountain valleys. The association is on the southern end of the Big Horn Mountains and extends the full length of the survey area. It forms a band, about 34 miles long and 5 to 14 miles wide, along the western edge of the survey area.

This association makes up about 15 percent of the survey area. About 12 percent of it is Nathrop soils, 8 percent is Starley soils, and 5 percent is Woosley soils. In addition, about 5 percent is Cloud Peak soils and 4 percent is Decross soils. The remaining 66 percent is Bachus, Poker, and Splitro soils, which formed in material weathered from sandstone; Amsden, Devoe, and Tripit soils, which formed in material weathered from red shale; Hazton and Burgess soils, which formed in material weathered from olive-colored shale; Leavitt soils, which formed in material weathered from limestone; Dell, Mathers, Pineguest, Sanford, and Wetterhorn soils, which formed in various material under forests; and areas of Rock outcrop.

The Nathrop soils are moderately steep and steep and occupy ridges and hillsides. They have a surface layer of grayish-brown stony loam, a subsoil of grayish-brown or brown stony clay loam or stony loam, and a substratum of pale-brown or very pale brown stony clay

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loam that extends to limestone bedrock at a depth of 20 to 40 inches. The Starley soils are moderately steep and steep and occupy ridges and hillsides. They have a surface layer of dark grayish-brown gravelly loam. This is underlain by pale-brown cobbly clay loam that extends to limestone bedrock at a depth of 8 to 20 inches. The Woosley soils are sloping and moderately steep and occupy hillsides. They have a surface layer of dark grayish-brown loam, a subsoil of grayish-brown, brown, or light brownish-gray loam or clay loam, and a substratum of light brownish-gray loam that extends to limestone bedrock at a depth of 20 to 40 inches.

The Cloud Peak soils are sloping to steep and occupy north-facing hillsides. The Decross soils are sloping or moderately steep and occupy alluvial fans in valleys in the mountains.

The soils of this association are used for summer range, woodland, wildlife habitat, and recreation. Desirable forage plants can be maintained if good range management practices are used. Only one of the major soils of this association is used as woodland. Access to the mountainous area is provided by the Hazelton Road, Thirty-three Mile Trail, the "Slip" road above Mayoworth, and the mountain slope road above Barnum. This association is not suitable for community or industrial development, except for recreation or summer cabins, because access is limited in winter.

Descriptions of the Soils

This section describes the soil series and mapping units in Johnson County, Southern Part. Each soil series is described in detail, and then briefly, each mapping unit in that series. Unless specifically mentioned otherwise, it is to be assumed that what is stated about the soil series holds true for the mapping units in that series. Thus, to get full information about any one mapping unit, it is necessary to read both the description of the mapping unit and the description of the soil series to which it belongs.

An important part of the description of each soil series is the soil profile, that is, the sequence of layers from the surface downward to rock or other underlying material. Each series contains two descriptions of this profile. The first is brief and in terms familiar to the layman. The second is much more detailed and is for those who need to make thorough and precise studies of soils. The profile described in the series is representative of mapping units in that series. If the profile of a given mapping unit is different from the one described for the series, these differences are stated in describing the mapping unit, or they are differences that are apparent in the name of the mapping unit. Color terms are for dry soil, unless otherwise stated.

As mentioned in the section "How This Survey Was Made," not all mapping units are members of a soil series. Alluvial land, for example, does not belong to a soil series, but nevertheless, is listed in alphabetic order along with the soil series.

Following the name of each mapping unit is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the capability unit and range site in which the mapping unit has been placed. The page for the description of each capability unit and range site can be learned by referring to the "Guide to Mapping Units" at the back of this survey.

The acreage and proportionate extent of each mapping unit are shown in table 1. Many of the terms used in describing soils can be found in the Glossary, and more detailed information about the terminology and methods of soil mapping can be obtained from the Soil Survey Manual (*6*).[2]

[2] Italic numbers in parentheses refer to Literature Cited, p. 154.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Area	Extent	Soil	Area	Extent
	Acres	*Percent*		*Acres*	*Percent*
Absted clay	409	(1)	Briggsdale-Worf association, rolling	6, 292	0. 5
Absted-Bone complex	1, 585	0. 1	Briggsdale-Worf association, hilly	5, 437	. 4
Absted-Wyarno complex, gently sloping	1, 951	. 2	Cloud Peak-Dell association	17, 276	1. 4
Absted-Wyarno complex, sloping	8, 460	. 7	Colluvial land	1, 807	. 1
Alluvial land	5, 980	. 5	Connerton silt loam, 0 to 3 percent slopes	609	. 1
Amsden-Decross association	2, 237	. 2	Connerton silt loam, 3 to 6 percent slopes	1, 785	. 1
Ascalon-Julesburg association	4, 476	. 4	Connerton silt loam, 6 to 10 percent slopes	2, 271	. 2
Auzqui-Slocum association	1, 506	. 1	Connerton silt loam, 10 to 30 percent slopes	314	(1)
Badland	25, 585	2. 3	Connerton silt loam, wet	416	(1)
Bankard sand	589	. 1	Connerton-La Fonda association	8, 317	. 7
Barnum silt loam	1, 853	. 1	Connerton-Spearfish association	6, 165	. 5
Barnum silt loam, sandy subsoil variant	436	(1)	Cragola-Ascalon association	3, 927	. 3
Barnum-Redbank association	4, 122	. 3	Cragola-Shingle association	5, 681	. 5
Bayerton-Tolman association	6, 528	. 5	Cushman-Briggsdale association	14, 808	1. 2
Big Horn-Wolf association	4, 424	. 4	Cushman-Embry association	1, 100	. 1
Briggsdale sandy loam, 0 to 6 percent slopes	219	(1)	Cushman-Terry association	2, 173	. 2
Briggsdale sandy loam, 6 to 10 percent slopes	865	. 1	Decross-Woosley association	19, 153	1. 6
Briggsdale-Bidman complex, rolling	8, 960	. 7	Devoe-Rock land complex, 10 to 30 percent slopes	6, 180	. 5
Briggsdale-Lohsman complex, rolling	26, 879	2. 4	Fort Collins loam, 0 to 3 percent slopes	1, 040	. 1
Briggsdale-Pugsley association	7, 075	. 6	Fort Collins loam, 3 to 6 percent slopes	1, 387	. 1
Briggsdale-Renohill association	30, 075	2. 9			

See footnote at end of table.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*—Continued

Soil	Area	Extent
	Acres	*Percent*
Fort Collins-Ascalon association	3, 285	0. 3
Fort Collins-Ulm association	4, 009	. 3
Gateson-Embry association	3, 645	. 3
Glenberg fine sandy loam	707	. 1
Glenberg fine sandy loam, sand substratum	1, 050	. 1
Glenberg-Bankard association	3, 373	. 3
Gullied land	1, 095	. 1
Harlan silt loam	270	[1]
Harlan-Kirtley association	3, 769	. 3
Haverson clay loam	1, 168	. 1
Haverson silt loam	2, 675	. 2
Haverson silt loam, wet	572	. 1
Haverson silt loam, sandy subsoil variant	1, 633	. 1
Haverson-Glenberg association	5, 180	. 4
Haverson-Glenberg association, saline	5, 490	. 4
Hazton-Burgess association	4, 176	. 3
Heldt silty clay loam, 0 to 3 percent slopes	627	. 1
Heldt silty clay loam, 3 to 6 percent slopes	418	[1]
Heldt silty clay loam, 6 to 10 percent slopes	342	[1]
Indart fine sandy loam	1, 033	. 1
Julesburg fine sandy loam	228	[1]
Keyner complex, 3 to 10 percent slopes	5, 415	. 4
Kim loam, 0 to 3 percent slopes	895	. 1
Kim loam, 3 to 6 percent slopes	1, 180	. 1
Kim loam, 6 to 10 percent slopes	569	. 1
Kim loam, wet	433	[1]
Kim-Haverson association	10, 392	. 9
Kim-Travessilla association	8, 155	. 7
Kim-Zigweid association, gently sloping	5, 135	. 4
Kim-Zigweid association, moderately steep	2, 355	. 2
La Fonda-Harlan association	3, 849	. 3
Leavitt-Passcreek association	6, 605	. 5
Limon silty clay, 0 to 3 percent slopes	960	. 1
Limon silty clay, 3 to 6 percent slopes	774	. 1
Limon silty clay, 6 to 10 percent slopes	707	. 1
Limon silty clay, saline, 0 to 6 percent slopes	1, 073	. 1
Limon silty clay, saline, 6 to 10 percent slopes	334	[1]
Limon-Cadoma association	9, 828	. 8
Limon-Gaynor association	9, 943	. 8
Lohmiller silty clay loam	1, 064	. 1
Lohsman-Orella complex, hilly	1, 032	. 1
Maysdorf sandy loam, 0 to 6 percent slopes	326	[1]
Maysdorf sandy loam, 6 to 10 percent slopes	216	[1]
Maysdorf association	1, 986	. 2
Maysdorf-Garrett association	3, 146	. 3
Maysdorf-Pugsley association	14, 743	1. 2
Maysdorf-Schooner association	4, 327	. 4
Moret-Kirtley association	3, 685	. 3
Moret-Rencalson complex, hilly	4, 607	. 4
Moret-Rock land complex, hilly	13, 006	1. 1
Moret-Shirk association	5, 118	. 4
Nathrop-Passcreek association	11, 921	1. 0
Nathrop-Starley association	11, 503	. 9
Nathrop-Woosley association	16, 065	. 3
Otero-Kim association	3, 534	1. 3
Passcreek-Sublette-Slipman association	7, 801	. 6
Petrie silty clay	1, 245	. 1
Petrie-Bone complex	13, 274	1. 1
Pineguest-Mathers association	7, 100	. 6
Pokeman-Gystrum-Rekop complex, hilly	6, 764	. 5
Poker-Bachus-Splitro association	8, 647	. 7
Potts-Kim association	3, 629	. 3
Potts-Kirtley association	2, 593	. 2
Pugsley-Gateson association	3, 117	. 3
Pugsley-Southfork complex, hilly	2, 976	. 2

Soil	Area	Extent
	Acres	*Percent*
Razor-Gaynor-Samsil complex, hilly	39, 036	3. 4
Renohill clay loam, 0 to 6 percent slopes	323	[1]
Renohill clay loam, 6 to 14 percent slopes	560	. 1
Renohill-Danko association	3, 050	. 3
Renohill-Razor association, rolling	44, 848	3. 9
Renohill-Razor association, undulating	2, 559	. 2
Rhoame silty clay, 0 to 6 percent slopes	308	[1]
Rhoame silty clay, 6 to 10 percent slopes	284	[1]
Rhoame complex	2, 083	. 2
Rhoame-Moret complex, hilly	2, 671	. 2
Rock land	22, 866	1. 9
Saline, wet land	1, 262	. 1
Samsil-Gaynor-Cadoma complex, rolling	7, 321	. 6
Samsil-Shale outcrop complex, steep	76, 714	6. 6
Samsil-Renohill association	2, 951	. 2
Sanford-Wetterhorn association	3, 712	. 3
Shale outcrop	7, 751	. 6
Shale rock land	13, 349	1. 1
Shingle clay loam	245	[1]
Shingle-Briggsdale association	3, 299	. 3
Shingle-Cushman association	18, 603	1. 5
Shingle-Kim association	15, 666	1. 3
Shingle-Kim association, valleys	52, 797	4. 6
Shingle-Tassel association	72, 721	6. 2
Shingle-Worf association	7, 607	. 6
Simmont-Rock outcrop complex, steep	5, 153	. 4
Spearfish-Shale outcrop complex, steep	22, 028	1. 8
Starley-Rock outcrop complex, steep	32, 318	2. 7
Stoneham loam, 0 to 3 percent slopes	2, 862	. 2
Stoneham loam, 3 to 6 percent slopes	2, 685	. 2
Stoneham loam, 6 to 10 percent slopes	225	[1]
Stoneham-Absted complex	5, 788	. 5
Stoneham-Ascalon association	8, 549	. 7
Stoneham-Cragola association	2, 324	. 2
Stoneham-Cushman association	34, 002	2. 9
Stoneham-Fort Collins association	8, 186	. 7
Stoneham-Kim association	3, 528	. 3
Stoneham-Zigweid association	12, 751	1. 0
Stubbs-Turk association	6, 887	. 6
Sunup-Rock outcrop complex, steep	21, 231	1. 7
Sunup-Carnero association	25, 302	2. 0
Terry-Tassel association	19, 598	1. 6
Travessilla-Rock outcrop complex, steep	4, 383	. 4
Tripit-Devoe association	6, 835	. 6
Tripit-Sawcreek association	2, 358	. 2
Turk-Lymanson-Jenkinson association	7, 732	. 6
Ulm loam, 0 to 3 percent slopes	417	[1]
Ulm loam, 3 to 6 percent slopes	408	[1]
Ulm-Cushman association	2, 137	. 2
Ulm-Wyarno association	2, 096	. 2
Valent-Cushman association	8, 288	. 7
Wolf-Cragola association	3, 611	. 3
Wormser-Englewood association	2, 092	. 2
Wormser-Shirk association	4, 765	. 4
Wyarno clay loam, 0 to 3 percent slopes	1, 323	. 1
Wyarno clay loam, 3 to 6 percent slopes	941	. 1
Wyarno-Limon association	6, 633	. 5
Wyarno-Stoneham association	1, 191	. 1
Zigweid loam, 0 to 3 percent slopes	1, 011	. 1
Zigweid loam, 3 to 6 percent slopes	1, 827	. 2
Zigweid-Keyner complex, hilly	2, 352	. 2
Stock-water ponds and dry lakes	4, 400	. 4
Gravel pits and Bentonite pits	110	[1]
Total	1, 198, 067	100. 0

[1] Less than 0.05 percent.

Absted Series

The Absted series consists of well-drained soils. These soils formed in material derived from alkaline shale on alluvial fans and hillsides. Slopes range from 0 to 10 percent. Elevations range from 4,500 to 5,000 feet. The average annual precipitation is 10 to 14 inches, the average annual soil temperature is 49° to 50° F., and the frost-free season is 105 to 110 days. The vegetation is western wheatgrass, blue grama, and cactus.

In a representative profile the surface layer is light brownish-gray, neutral very fine sandy loam about 1 inch thick. The subsurface layer is light brownish-gray, neutral very fine sandy loam about 2 inches thick. The upper part of the subsoil is brown, moderately alkaline clay about 5 inches thick. The lower part of the subsoil is light olive-brown, very strongly alkaline clay about 4 inches thick. The substratum is light olive-brown, very strongly alkaline clay that extends to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is moderate. The effective rooting depth is 40 to 60 inches or more.

These soils are used for range, for irrigated hay and pasture, as wildlife habitat, and in some areas for dryland spring wheat.

Representative profile of Absted very fine sandy loam, in an area of Absted-Wyarno complex, sloping, near the west quarter corner of sec. 16, T. 45 N., R. 80 W.

A1—0 to 1 inch, light brownish-gray (2.5Y 6/2) very fine sandy loam, grayish brown (2.5Y 5/2) moist; moderate, fine, granular structure; soft, very friable; neutral; clear, smooth boundary.

A2—1 to 3 inches, light brownish-gray (2.5Y 6/2) very fine sandy loam, grayish brown (2.5Y 5/2) moist; moderate, thin, platy structure parting to moderate, fine, granular; soft, very friable; neutral; abrupt, smooth boundary.

B2t—3 to 8 inches, brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; strong, medium, columnar structure parting to strong, medium, angular blocky; slightly hard, very plastic; aggregates are extremely hard; thin, continuous, waxlike coatings on ped faces; waxlike coatings and fillings on inside of root channels and pores; slight effervescence; moderately alkaline; gradual, wavy boundary.

B3sa—8 to 12 inches, light olive-brown (2.5Y 5/3) clay, olive brown (2.5Y 4/3) moist; weak, medium, prismatic structure parting to strong, medium, angular blocky; hard, very plastic; peds are extremely hard; thin wavy patches on some ped faces; visible accumulation of soluble salts as soft concretions and thin seams; strong effervescence; very strongly alkaline; diffuse, wavy boundary.

Csa—12 to 60 inches, light olive-brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) moist; massive; extremely hard, very plastic; visible secondary accumulations of soluble salts as soft concretions and thin seams, but their number decreases as depth increases; strong effervescence; very strongly alkaline.

Depth to bedrock is 40 to 60 inches or more, depth to strongly calcareous material ranges from 8 to 12 inches, and thickness of the solum ranges from 8 to 19 inches.

The A2 horizon ranges from 5Y to 10YR in hue, is 6 or 7 in value when dry and 5 or 6 when moist, and ranges from 2 to 4 in chroma when dry or moist. It ranges from neutral to mildly alkaline. In most places it has platy primary structure, but in some places it has fine granular structure. This horizon is soft or slightly hard when dry.

The B2t horizon ranges from 2.5Y to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It ranges from moderately alkaline to very strongly alkaline. Content of exchangeable sodium ranges from 3 to 12 percent in the upper part of the B2t horizon and from 15 to 25 percent in the lower part. This horizon generally has texture of clay, but in some places it is silty clay, silty clay loam, or clay loam.

The Csa horizon ranges from 5Y to 10YR in hue. It ranges from strongly alkaline to very strongly alkaline. Content of exchangeable sodium ranges from 15 to 30 percent. The calcium carbonate equivalent ranges from 6 to 15 percent.

Absted clay (Aa).—This soil is on alluvial fans. It has a profile similar to the one described as representative of the series, except that the surface layer is clay about 5 to 8 inches thick. Slopes are 0 to 6 percent.

Included with this soil in mapping are areas of Bone and Wyarno soils.

Water intake is slow. Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used for dryland spring wheat and hay and for irrigated hay and pasture. The surface layer is difficult to till, and the soil is or has been cultivated. (Capability units VIs–71, dryland, and VIs–71, irrigated; Clayey range site, 10 to 14 inch precipitation zone)

Absted-Bone complex (AB).—This complex is about 50 percent Absted very fine sandy loam, 0 to 6 percent slopes, and about 30 percent Bone loam, 0 to 6 percent slopes. These soils are nearly level to gently sloping. They are intermingled in a complex pattern on alluvial fans.

Included with these soils in mapping are areas of Stoneham and Wyarno soils that make up about 20 percent of the acreage.

Runoff is medium and the hazard of water erosion is moderate on the Absted soil. Runoff is medium to rapid and the hazard of erosion is moderate to high on the Bone soil. If the cover on the Absted soil is destroyed, the hazard of wind erosion is high.

Soils of this complex are used for range and wildlife habitat. (Capability unit VIs–71, dryland. Absted soil in Loamy range site, 10 to 14 inch precipitation zone, and Bone soil in Dense Clay range site, 10 to 14 inch precipitation zone)

Absted-Wyarno complex, gently sloping (ADB).—This complex is about 45 percent Absted very fine sandy loam, 0 to 6 percent slopes, and about 30 percent Wyarno clay loam, 0 to 6 percent slopes. These soils are intermingled in a complex pattern on alluvial fans.

Included with these soils in mapping are areas of Bone soils that make up about 15 percent of the acreage and areas of Ulm soils that make up about 10 percent.

Runoff is medium, and the hazard of water erosion is moderate. If the cover is destroyed, the hazard of wind erosion is high on the Absted soil.

Soils of this complex are used for range and wildlife habitat. (Capability unit VIs–71, dryland. Absted soil in Loamy range site, 10 to 14 inch precipitation zone, and Wyarno soil in Clayey range site, 10 to 14 inch precipitation zone)

Absted-Wyarno complex, sloping (ADC).—This complex is about 35 percent Absted very fine sandy loam, 6 to 10 percent slopes; about 30 percent Wyarno clay loam, 6 to 10 percent slopes; and about 20 percent Bone loam, 6 to 10 percent slopes. The Absted soil has the profile described as representative of the Absted series.

The Wyarno and Bone soils have a profile similar to the one described as representative of the Wyarno and Bone series, except that the surface layer and subsoil are thinner. These soils are intermingled in a complex pattern on alluvial fans.

Included with these soils in mapping are areas of Cadoma soils that make up about 10 percent of the acreage and areas of Limon soils that make up about 5 percent.

Runoff is medium to rapid, and the hazard of water erosion is moderate to high. If the cover is destroyed, the hazard of wind erosion is high on the Absted soil.

Soils of this complex are used for range and wildlife habitat. (Capability unit VIe–71, dryland. Absted soil in Loamy range site, 10 to 14 inch precipitation zone; Wyarno soil in Clayey range site, 10 to 14 inch precipitation zone; and Bone soil in Dense Clay range site, 10 to 14 inch precipitation zone)

Alluvial Land

Alluvial land (Al) consists of highly stratified soil materials that range from loam to sand in texture and are more than 60 inches thick. These materials make up the sand and gravel bars and old stream meanders along the Powder River and its tributaries. This land type is subject to frequent flooding and deposition. Slopes range from 0 to 3 percent. Elevations range from 4,500 to 5,000 feet, and the average annual precipitation is 10 to 12 inches. The vegetation is sparse and is mainly cottonwood trees, willows, and western wheatgrass.

Permeability ranges from moderate to very rapid. Roots can penetrate to a depth of 60 inches or more. Runoff is slow, and the hazard of water erosion is only slight, but that of wind erosion is high.

Alluvial land is used for range and as wildlife habitat. (Capability unit VIe–15, dryland; Sands range site, 10 to 14 inch precipitation zone)

Amsden Series

The Amsden series consists of sloping to moderately steep, well-drained soils. These soils formed in alluvium derived from reddish-colored sandstone and shale. They are on alluvial fans in the mountains. Slopes range from 6 to 15 percent. Elevations range from 7,500 to 9,500 feet. The average annual precipitation is 15 to 19 inches, the average annual soil temperature is 39° to 40° F., and the average summer soil temperature is 55° F. The frost-free season is 60 to 65 days, although frost can occur in any month. The vegetation is mountain sedges and grasses dominated by Idaho fescue.

In a representative profile the surface layer is dark grayish-brown or brown, neutral loam about 8 inches thick. The upper part of the subsoil is reddish-brown, neutral loam about 4 inches thick. The lower part of the subsoil is reddish-brown, neutral and moderately alkaline clay loam about 18 inches thick. The substratum is light reddish-brown, moderately alkaline clay loam that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is 40 inches to 60 inches or more.

These soils are used for range and wildlife habitat.

Representative profile of Amsden loam, in an area of Amsden-Decross association, near the center of sec. 29, T. 46 N., R. 84 W.

A11—0 to 4 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate, fine, granular and crumb structure; soft, very friable; neutral; clear, smooth boundary.

A12—4 to 8 inches, brown (7.5YR 4/2) loam, very dark brown (7.5YR 2/2) moist; moderate, medium, subangular blocky structure parting to moderate, fine, granular; slightly hard, very friable; neutral; clear, smooth boundary.

B1—8 to 12 inches, reddish-brown (5YR 5/3) loam, dark reddish brown (5YR 3/3) moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, very friable; few, thin, waxy patches on all ped faces; neutral; clear, smooth boundary.

B2t—12 to 23 inches, reddish-brown (5YR 5/3) clay loam, reddish brown (5YR 4/3) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, friable; peds are extremely hard; thin, continuous, waxy coatings on ped faces; neutral; clear, smooth boundary.

B3ca—23 to 30 inches, reddish-brown (5YR 5/3) clay loam, reddish brown (5YR 4/3) moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky; hard, friable; few, thin, waxy patches, mainly on vertical ped faces; weak accumulation of secondary calcium carbonate occurring as soft concretions; strong effervescence; moderately alkaline; diffuse, wavy boundary.

Cca—30 to 60 inches, light reddish-brown (5YR 6/3) clay loam, reddish brown (5YR 5/3) moist; massive; hard, friable; moderate accumulation of secondary calcium carbonate occurring as soft concretions and in thin seams and streaks; strong effervescence; moderately alkaline.

Depth to bedrock is 40 to 60 inches or more, depth to calcareous material ranges from 15 to 30 inches, and thickness of the solum ranges from 15 to 40 inches.

The A1 horizon ranges from 10YR to 5YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. It ranges from neutral to mildly alkaline. In most places it has granular or crumb structure, but in some places it has subangular blocky structure. This horizon is soft or slightly hard when dry.

The B2t horizon ranges from 5YR to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It ranges from neutral to moderately alkaline. It has texture of loam or clay loam. Less than 35 percent of the sand fraction is fine sand or coarser.

The Cca horizon ranges from 5YR to 10YR in hue. It ranges from moderately alkaline to strongly alkaline. The calcium carbonate equivalent ranges from 6 to 14 percent.

Amsden-Decross association (AM).—This association is about 40 percent Amsden loam, 6 to 15 percent slopes, and about 30 percent Decross loam, 6 to 15 percent slopes. These soils occupy alluvial fans in the mountains. The Amsden soil is on upper slopes where the alluvium is derived from reddish-colored shale. The Decross soil is on lower slopes below the Amsden soil.

Included with these soils in mapping are areas of Tripit soils that make up about 20 percent of the acreage and areas of a reddish-colored silty clay soil that make up about 10 percent.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

Soils of this association are used for range. (Capability unit VIe–2, dryland; Loamy range site, 15 to 19 inch precipitation zone)

Ascalon Series

The Ascalon series consists of gently sloping to moderately steep, well-drained soils. These soils formed in alluvium derived from sandstone and siltstone. They are on alluvial fans and foot slopes, mainly in the area of Meadow Creek. Slopes range from 3 to 15 percent. Elevations range from 5,000 to 5,500 feet. The average annual precipitation is 12 to 14 inches, the average annual soil temperature is about 50° F., and the frost-free season is about 100 days. The vegetation is western wheatgrass, big sagebrush, and blue grama.

In a representative profile the surface layer is dark-brown, neutral or mildly alkaline fine sandy loam about 10 inches thick. The upper part of the subsoil is brown, mildly alkaline sandy clay loam about 11 inches thick. The lower part of the subsoil is dark yellowish-brown, moderately alkaline sandy clay loam about 7 inches thick. The substratum is pale-brown, strongly alkaline sandy clay loam that extends to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more.

These soils are used for range and as wildlife habitat.

Representative profile of Ascalon fine sandy loam, in an area of Ascalon-Julesburg association, in the NW¼ NW¼ sec. 20, T. 41 N., R. 76 W.

A11—0 to 6 inches, dark-brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) moist; weak, coarse, crumb structure; loose, very friable, nonsticky and nonplastic; neutral; many roots; clear, smooth boundary.

A12—6 to 10 inches, dark-brown (10YR 4/3) fine sandy loam, dark brown (10YR 3/3) moist; weak, medium, angular blocky structure; soft, very friable, slightly sticky and slightly plastic; mildly alkaline; many roots; clear, smooth boundary.

B2t—10 to 21 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate, medium, prismatic structure parting to moderate, fine and medium, subangular blocky; thick continuous clay films on ped faces; hard, firm, sticky and plastic; mildly alkaline; few roots; clear, smooth boundary.

B3ca—21 to 28 inches, dark yellowish-brown (10YR 4/4) sandy clay loam, dark brown (10YR 4/3) moist; weak, coarse, subangular blocky structure; thin discontinuous clay films on vertical ped faces and in root channels; slightly hard, friable, slightly sticky and slightly plastic; strong effervescence; few fine threads and specks of calcium carbonate; moderately alkaline; few roots; clear, smooth boundary.

Cca—28 to 60 inches, pale-brown (10YR 6/3) sandy clay loam, brown (10YR 5/3) moist; massive; soft, very friable, slightly sticky and slightly plastic; strong effervescence; many fine threads and specks of calcium carbonate; strongly alkaline.

Depth to carbonates ranges from 16 to 28 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 10 percent.

The A horizon ranges from 10YR to 7.5YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist.

The B2t horizon ranges from 10YR to 7.5YR in hue, ranges from 4 to 6 in value when dry and is 4 or 5 when moist, and ranges from 3 to 5 in chroma when dry or moist.

Ascalon-Julesburg association (AS).—This association is about 30 percent Ascalon fine sandy loam, 3 to 15 percent slopes; about 25 percent Julesburg sandy loam, 6 to 20 percent slopes; and about 20 percent Maysdorf sandy loam, 6 to 15 percent slopes. The Ascalon and Julesburg soils have the profiles described as representative of the Ascalon and Julesburg series. These soils occupy alluvial fans and foot slopes. The Ascalon soil is on lower slopes, the Julesburg soil is on upper fan slopes, and the Maysdorf soil is on foot slopes above the other soils.

Included with these soils in mapping are areas of Fort Collins soils that make up about 15 percent of the acreage and areas of Stoneham soils that make up about 10 percent.

Runoff is medium to rapid, and the hazard of water erosion is moderate to high. If the cover is destroyed, the hazard of wind erosion is high.

Soils of this association are used for range and wildlife habitat. (Capability unit VIe–5, dryland. Ascalon and Maysdorf soils in Loamy range site, 10 to 14 inch precipitation zone, and Julesburg soil in Sandy range site, 10 to 14 inch precipitation zone)

Auzqui Series

The Auzqui series consists of sloping to moderately steep, moderately well drained soils. These soils formed in alluvium derived from limestone. They are on alluvial fans in the mountains. Slopes range from 6 to 15 percent. Elevations range from 7,600 to 9,000 feet. The average annual precipitation is 18 to 19 inches, the average annual soil temperature is 40° F., and the average summer soil temperature is about 54° F. The frost-free season is 60 to 65 days, although frost can occur in any month. The vegetation is mountain sedges and grasses dominated by Idaho fescue.

In a representative profile the surface layer is dark-gray, moderately alkaline loam about 12 inches thick. The underlying layers are gray and light brownish-gray, moderately alkaline clay loam that reaches to a depth of 60 inches and more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is 40 to 60 inches or more.

These soils are used for range and wildlife habitat.

Representative profile of Auzqui loam, in an area of Auzqui-Slocum association, near Billy Creek in the NW¼NE¼ sec. 4, T. 46 N., R. 85 W.

A1—0 to 12 inches, dark-gray (10YR 4/1) loam, black (10YR 2/1) moist; strong, fine, granular structure; soft, very friable; strong effervescence; moderately alkaline; gradual, wavy boundary.

AC—12 to 16 inches, gray (2.5Y 6/1) clay loam, gray (2.5Y 5/1) moist; weak, medium, subangular blocky structure parting to moderate, fine, granular; slightly hard, very friable; strong effervescence; moderately alkaline; gradual, wavy boundary.

C—16 to 60 inches, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; massive; hard, very friable; strong effervescence; moderately alkaline.

These soils generally are calcareous throughout, but in some areas they are noncalcareous in the uppermost few inches. Depth to bedrock is 40 inches or more and in most places is more than 60 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 10 percent.

The A horizon ranges from 2.5Y to 10YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and ranges from 1 to 3 chroma when dry or moist. It ranges from mildly alkaline to strongly alkaline. In most places it has crumb or granular structure, but in some places it has weak, subangular

blocky structure. This horizon is soft or slightly hard when dry.

The C horizon ranges from 2.5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It ranges from moderately alkaline to strongly alkaline.

Auzqui-Slocum association (AU).—This association is about 50 percent Auzqui loam, 6 to 15 percent slopes, and about 30 percent Slocum silt loam, 3 to 10 percent slopes. These soils have the profiles described as representative of the Auzqui and Slocum series. They occupy valleys along mountain streams. The Slocum soil is adjacent to the stream, and the Auzqui soil is in areas above the Slocum soil.

Included with these soils in mapping are areas of Leavitt soils that make up about 10 percent of the acreage. Also included are areas of Decross soils that make up about 5 percent of the acreage and stream meanders that make up about 5 percent.

Runoff is medium to rapid on the Auzqui soil and slow to medium on the Slocum soil. The hazard of water erosion is moderate to high on the Auzqui soil and slight to moderate on the Slocum soil.

Soils of this association are used for range and wildlife habitat. (Capability unit VIe–2, dryland. Auzqui soil in Loamy range site, 15 to 19 inch precipitation zone, and Slocum soil in Subirrigated range site, 15 to 19 inch precipitation zone)

Bachus Series

The Bachus series consists of sloping to moderately steep, well-drained soils. These soils formed in residuum weathered from sandstone. They are on uplands in the mountains. Slopes range from 6 to 20 percent. Elevations range from 8,000 to 9,000 feet. The average annual precipitation is 15 to 19 inches, the average annual soil temperature is 41° F., and average summer soil temperature is about 53° F. The frost-free season is 60 to 65 days, although frost can occur in any month. The vegetation is Idaho fescue and thickspike wheatgrass.

In a representative profile the surface layer is dark grayish-brown, slightly acid loam about 17 inches thick. The subsoil is brown, medium acid loam or clay loam about 14 inches thick. It is underlain by hard quartzitic sandstone at a depth of 31 inches.

Permeability is moderate, and the available water capacity is low to moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Bachus loam, in an area of Poker-Bachus-Splitro association, in the NE¼NE¼ sec. 30, T. 45 N., R. 85 W.

A1—0 to 13 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; strong, fine, granular structure; slightly hard, very friable; slightly acid; clear, smooth boundary.

A3—13 to 17 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure parting to strong, fine, granular; slightly hard, very friable; peds are hard; slightly acid; gradual, smooth boundary.

B21t—17 to 26 inches, brown (10YR 5/3) loam or clay loam, dark brown (10YR 3/3) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, very friable; peds are very hard; common, thin, waxlike patches on ped faces; thin waxlike coatings in root channels and pores; medium acid; gradual, smooth boundary.

B22t—26 to 31 inches, brown (7.5YR 5/4) loam or clay loam, dark brown (7.5YR 4/4) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, very friable; peds are very hard; thin waxlike patches on ped surfaces; waxlike fillings and coatings in root channels and pores; 10 percent sandstone channery fragments; medium acid; gradual, wavy boundary.

R—31 inches, hard, quartzitic sandstone; noncalcareous.

Depth to bedrock ranges from 20 to 40 inches. Content of coarse fragments ranges from 0 to 15 percent.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and ranges from 1 to 3 in chroma when dry or moist. It ranges from medium acid to slightly acid. In most places it has granular or crumb structure, but in some places it has subangular blocky structure. This horizon is soft or slightly hard when dry.

The B21t horizon ranges from 10YR to 5YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and ranges from 1 to 3 in chroma when dry or moist. The B22t horizon ranges from 10YR to 5YR in hue, is 5 or 6 in value when dry and 3 to 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. The B horizon ranges from medium acid to slightly acid. It has prismatic or subangular blocky structure. It has texture of loam, clay loam, or sandy clay loam. More than 15 percent but less than 35 percent is fine sand or coarser.

Bachus soils are mapped in an association with Poker and Splitro soils.

Badland

Badland (BA) consists of steep or very steep, nearly barren land that is broken by many intermittent drainageways (fig. 4). Areas of Badland are mainly on the eastern side of Powder River below Sussex, in the Red Wall area near Barnum and Mayoworth, along Alkali Creek, and in the uplands adjacent to the South Fork of Powder River. The vegetation is confined to the small areas of soil and is mainly mountain-mahogany and threadleaf sedge. Included in mapping with this land type are areas where sandstone, siltstone, and shale are exposed and small areas of soil.

Badland is used as wildlife habitat. (Capability unit VIIIe–82, dryland; not in a range site)

Bankard Series

The Bankard series consists of nearly level, somewhat excessively drained soils. These soils formed in sandy alluvium on flood plains, mainly along the Middle Fork of Powder River. Slopes range from 0 to 3 percent. Elevations range from 4,500 to 5,000 feet. The average annual precipitation is 10 to 14 inches, the average annual soil temperature is about 51° F., and the frost-free season is 110 to 120 days. The vegetation is silver sagebrush, western wheatgrass, and cactus.

In a representative profile the surface layer is grayish-brown, mildly alkaline loamy sand about 3 inches thick. Next is a layer of pale-brown loamy fine sand about 15 inches thick. The underlying material is light brownish-gray, moderately alkaline loamy fine sand, about 12 inches thick, underlain by pale-olive and light olive-gray, moderately alkaline loamy sand that extends to a depth of 60 inches or more.

Permeability is rapid, and the available water capacity is low. The effective rooting depth is 60 inches or more.

Figure 4.—**Badland in an area east of Powder River and northeast of Sussex.**

These soils are used for range and for irrigated hay, pasture, and small grain.

Representative profile of Bankard loamy sand, in an area of Glenberg-Bankard association, in the NE¼NE¼ sec. 16, T. 44 N., R. 78 W.

A1—0 to 3 inches, grayish-brown (2.5Y 5/2) loamy sand, dark grayish brown (2.5Y 4/2) moist; weak, medium, and coarse, crumb structure; loose, very friable, nonsticky and nonplastic; slight effervescence; mildly alkaline; many roots; clear, smooth boundary.

AC—3 to 18 inches, pale-brown (10YR 6/3) loamy fine sand, grayish brown (2.5Y 5/2) moist; weak, medium, crumb structure parting to single grained; loose, very friable, nonsticky and nonplastic; strong effervescence; moderately alkaline; many roots to a depth of 10 inches, few roots below; clear, smooth boundary.

C1—18 to 30 inches, light brownish-gray (2.5Y 6/2) loamy fine sand, dark grayish brown (2.5Y 4/2) moist; weak, coarse, crumb structure; slightly hard, very friable, nonsticky and nonplastic; strong effervescence; moderately alkaline; very few roots; clear, smooth boundary.

C2—30 to 43 inches, pale-olive (5Y 6/3) loamy sand, olive (5Y 4/3) moist; single grained; loose, friable, nonsticky and nonplastic; strong effervescence; moderately alkaline; very few roots; gradual, wavy boundary.

C3—43 to 60 inches, light olive-gray (5Y 6/2) loamy sand, olive brown (2.5Y 4/4) moist; single grained; loose, nonsticky and nonplastic; strong effervescence; moderately alkaline; gradual, wavy boundary.

These soils generally are calcareous throughout, but in places they are noncalcareous in the uppermost few inches. They range from mildly alkaline to strongly alkaline in reaction. Their profile has textures mainly of loamy fine sand, loamy sand, and sand, but lenses of sandy loam and loam are common. Hue ranges from 10YR to 5Y, value is 4 or 5 when moist and 5 or 6 when dry, and chroma is 2 to 4 when dry or moist. The content of coarse fragments ranges from 0 to 10 percent.

Bankard sand (Bd).—This soil is on flood plains where it is occasionally flooded. It has a profile similar to the one described as representative of the series, except that the surface layer is sand about 6 inches thick. Slopes are 0 to 3 percent. Included in mapping are small areas of Glenberg and Haverson soils and gravel deposits.

Runoff is slow, and the hazard of water erosion is only slight. If the soil is left bare, the hazard of wind erosion is high.

This soil is used for irrigated hay, pasture, and small grain. (Capability units VIe-15, dryland, and IVs-15, irrigated; Sands range site, 10 to 14 inch precipitation zone)

Barnum Series

The Barnum series consists of nearly level, well-drained soils. These soils formed in reddish-colored alluvium on flood plains. They are mainly along the Red Fork of Powder River, Beaver Creek, and Buffalo Creek in the Barnum area; along the North Fork of Powder River; and along the Middle Fork of Powder River above Kaycee. Slopes range from 0 to 3 percent. Elevations range from 5,000 to 5,500 feet. The average annual precipitation is 12 to 13 inches, the average annual soil temperature is about 50° F., and the frost-free season is 100 to 105 days.

The vegetation is basin wildrye and western wheatgrass.

In a representative profile the surface layer is reddish-brown, moderately alkaline very fine sandy loam about 4 inches thick. The underlying material is reddish-brown, moderately alkaline loam that is stratified with thin lenses of fine sandy loam or clay loam. This material reaches to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more. The seasonal high water table is below a depth of 40 inches.

These soils are used for range; for irrigated hay, pasture, and small grain; and as wildlife habitat.

Representative profile of Barnum very fine sandy loam, in an area of Barnum-Redbank association, in the NW¼ NE¼ sec. 6, T. 41 N., R. 83 W.

A1—0 to 4 inches, reddish-brown (5YR 5/4) very fine sandy loam, reddish brown (5YR 4/4) moist; moderate, very fine, granular structure; soft, very friable; strong effervescence; moderately alkaline; clear, smooth boundary.

C—4 to 60 inches, reddish-brown (2.5YR 5/5) loam stratified with thin lenses of fine sandy loam or clay loam, reddish brown (2.5YR 4/5) moist; massive; hard, very friable; strong effervescence; moderately alkaline.

These soils generally are calcareous to the surface, but in places they are leached in the uppermost few inches. The calcium carbonate equivalent ranges from less than 1 percent to about 5 percent. The weighted average texture between depths of 10 and 40 inches generally is loam or clay loam. Content of coarse fragments ranges from 0 to 10 percent but typically is less than 5 percent.

The A1 horizon ranges from 7.5YR to 2.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 5 in chroma when dry or moist. It is moderately alkaline or strongly alkaline. In most places it has granular structure, but in some places it has subangular blocky structure. This horizon is soft or slightly hard when dry.

The C horizon ranges from 5YR to 10R in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 4 to 6 in chroma when dry or moist. It is moderately alkaline or strongly alkaline.

Barnum silt loam (Be).—This soil is on flood plains adjacent to the channels of streams that traverse the red beds. Many areas are occasionally flooded. This soil has a profile similar to the one described as representative of the series, except that the surface layer is silt loam 6 to 8 inches thick. Slopes are 0 to 3 percent.

Included with this soil in mapping are areas of Redbank soils and Barnum silt loam, sandy subsoil variant. Also included are small, wet depressions.

Runoff is slow, and the hazard of water erosion is slight to moderate. The hazard of wind erosion is high.

This soil is used for irrigated hay, pasture, and small grain. (Capability units IVe–3, dryland, and IIe–3, irrigated; Lowland range site, 10 to 14 inch precipitation zone)

Barnum-Redbank association (BK).—This association is about 50 percent Barnum very fine sandy loam, 0 to 3 percent slopes, and about 25 percent Redbank fine sandy loam, 0 to 3 percent slopes. These soils have the profiles described as representative of the Barnum and Redbank series. They occupy flood plains and are occasionally flooded. Generally, the Barnum soil is on the part of the flood plain that is farthest from the stream, and the Redbank soil is on the part that is nearest or adjacent to the stream.

Included with these soils in mapping are areas of Barnum silt loam, sandy subsoil variant, that make up about 15 percent of the acreage, areas of Connerton soils that make up about 5 percent, and stream channels that make up about 5 percent.

Runoff is slow, and the hazard of water erosion is slight to moderate. If the cover is destroyed, the hazard of wind erosion is high.

Soils of this association are used for range and as wildlife habitat. (Barnum soil in capability unit IVe–3, dryland, and Redbank soil in capability unit IVe–5, dryland. Both soils in Lowland range site, 10 to 14 inch precipitation zone)

Barnum Series, Sandy Subsoil Variant

The Barnum series, sandy subsoil variant, consists of nearly level, well-drained soils. These soils formed in mixed, reddish-colored alluvium on flood plains. They are along the Red Fork of Powder River, Beaver Creek, and the Middle Fork of Powder River, above Kaycee. Slopes range from 0 to 3 percent. Elevations range from 5,000 to 5,500 feet. The average annual precipitation is 12 to 13 inches, the average annual soil temperature is 50° F., and the frost-free season is 100 to 105 days. The vegetation is basin wildrye and western wheatgrass.

In a representative profile the surface layer is reddish-brown, moderately alkaline silt loam about 7 inches thick. The underlying layers are reddish-brown, moderately alkaline loam that is stratified with thin lenses of fine sandy loam and clay loam and is about 17 inches thick over reddish-brown, moderately alkaline fine sand that is stratified with thin lenses of loam and loamy sand to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more. The seasonal high water table is below a depth of 40 inches, but the soil is flooded occasionally.

These soils are used for irrigated hay, pasture, and small grain.

Representative profile of Barnum silt loam, sandy subsoil variant, in the NW¼NW¼ sec. 2, T. 42 N., R. 83 W.

Ap—0 to 7 inches, reddish-brown (5YR 5/4) silt loam, reddish brown (5YR 4/4) moist; moderate, fine, granular structure; soft, very friable, slightly sticky and slightly plastic; strong effervescence; moderately alkaline; clear, smooth boundary.

C1—7 to 24 inches, reddish-brown (2.5YR 5/5) loam stratified with thin lenses of fine sandy loam and clay loam, reddish brown (2.5YR 4/5) moist; massive; hard, friable, slightly sticky and slightly plastic; strong effervescence; moderately alkaline; clear, smooth boundary.

C2—24 to 60 inches, reddish-brown (2.5YR 5/5) fine sand stratified with thin lenses of loam and loamy sand, reddish brown (2.5YR 4/5) moist; single grained; loose, very friable, nonsticky and nonplastic; strong effervescence; moderately alkaline.

These soils generally are calcareous throughout, but in places they are noncalcareous in the uppermost few inches. Content of coarse fragments ranges from 0 to 10 percent. These soils range from mildly alkaline to strongly alkaline.

The A horizon ranges from 7.5YR to 2.5YR in hue, is 4 or 5 in value when dry or moist, and ranges from 2 to 5 in chroma when dry or moist.

The C horizon ranges from 5YR to 10R in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 4 to 6 in chroma when dry or moist.

Barnum silt loam, sandy subsoil variant (Bf).—This soil is on flood plains adjacent to stream channels and in areas subject to deposition during flooding. It has the profile described as representative of the Barnum series, sandy subsoil variant. Slopes are 0 to 3 percent.

Included with this soil in mapping are some areas of Barnum silt loam, Redbank soils, and small wet areas.

Runoff is slow, and the hazard of water erosion is slight to moderate. If the soil is left bare, the hazard of wind erosion is high.

This soil is used for irrigated hay, pasture, and small grain and for range. Cuts made during land leveling need to be limited to a depth of less than 24 inches to avoid exposing the sandy substratum. (Capability units IVe–3, dryland, and IIe–3, irrigated; Lowland range site, 10 to 14 inch precipitation zone)

Bayerton Series

The Bayerton series consists of moderately steep to steep, well-drained soils. These soils formed in residuum weathered from sandstone bedrock. They are on north-facing hillsides along the mountain flank. Slopes range from 10 to 30 percent. Elevations range from 6,000 to 7,500 feet. The average annual precipitation is 14 to 16 inches, the average soil temperature is 44° to 46° F., and the frost-free season is 80 to 85 days. The vegetation is ponderosa pine, Idaho fescue, and pinegrass.

In a representative profile these soils have 3 inches of forest litter over a surface layer of dark grayish-brown, slightly acid loam about 2 inches thick. The subsurface layer is light-brown, slightly acid fine sandy loam about 9 inches thick, the lower 4 inches of which is mixed with material from the subsoil. The upper part of the subsoil is brown, neutral sandy clay loam about 9 inches thick, and the lower part of the subsoil is light-gray, moderately alkaline sandy clay loam about 4 inches thick. Hard sandstone is at a depth of about 24 inches.

Permeability is moderate, and the available water capacity is low to moderate. The effective rooting depth is 20 to 40 inches.

These soils are used as woodland, wildlife habitat, and watershed.

Representative profile of Bayerton loam, in an area of Bayerton-Tolman association, in the SW¼ sec. 30, T. 45 N., R. 83 W.

O1—3 inches to 1 inch, organic material that consists mainly of needles, twigs, and bark.

O2—1 inch to 0, partly decomposed organic material that consists mainly of needles, twigs, and bark.

A1—0 to 2 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate, fine, crumb structure; soft, very friable; 5 percent sandstone fragments less than 10 inches in diameter; slightly acid; abrupt, wavy boundary.

A2—2 to 7 inches, light-brown (7.5YR 6/3) fine sandy loam, brown (7.5YR 5/3) moist; moderate, thin, platy structure parting to moderate, fine, granular; slightly hard, very friable; vesicular; 5 percent fine sandstone gravel and channery fragments; slightly acid; gradual, wavy boundary.

A&B—7 to 11 inches, mixed colors, fine sandy loam embedded with nodules and fragments of sandy clay loam, colors include brown (7.5YR 5/3) and dark brown (7.5YR 4/3) moist; weak, fine, subangular blocky structure; slightly hard, very friable; few, thin, shiny patches on faces of the more clayey aggregates; 5 percent sandstone gravel and channery fragments; slightly acid; gradual, wavy boundary.

B2t—11 to 20 inches, brown (7.5YR 5/3) sandy clay loam, dark brown (7.5YR 4/3) moist; moderate, medium, subangular blocky structure; hard, very friable; thin, nearly continuous, waxlike coatings on ped faces; 5 percent sandstone gravel and channery fragments; neutral; abrupt, smooth boundary.

B3ca—20 to 24 inches, light-gray (10YR 7/1) sandy clay loam, gray (10YR 6/1) moist; weak subangular blocky structure; slightly hard, very friable; few, thin, waxlike patches on ped faces; 5 percent sandstone channery fragments; moderate accumulation of secondary calcium carbonate occurring as soft concretions and in thin seams and streaks; strong effervescence; moderately alkaline; abrupt, smooth boundary.

R—24 inches, hard sandstone bedrock.

Depth to bedrock ranges from 20 to 40 inches, and depth to calcareous material ranges from 15 to 36 inches. Content of coarse fragments ranges from 0 to 15 percent.

The A2 horizon ranges from 10YR to 7.5YR in hue, is 6 or 7 in value when dry and 5 or 6 when moist, and ranges from 2 to 4 in chroma when dry or moist. It ranges from medium acid to mildly alkaline. In most places it has platy structure, but in some places it has granular structure. This horizon is soft or slightly hard when dry.

The B2t horizon ranges from 10YR to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 3 or 4 in chroma when dry or moist. It generally has texture of sandy clay loam, but in some places it is loam or sandy loam. More than 35 percent is fine sand or coarser.

The B3ca horizon ranges from 2.5Y to 7.5YR in hue. The calcium carbonate equivalent ranges from 4 to 10 percent.

Bayerton-Tolman association (BM).—This association is about 40 percent Bayerton loam, 10 to 30 percent slopes; about 30 percent Tolman very stony loam, 10 to 40 percent slopes; and about 15 percent Rock land (fig. 5). These soils have the profiles described as representative of the Bayerton and Tolman series. The Bayerton soil occupies north-facing hillsides, and the Tolman soil occupies east-facing hillsides.

Included with these soils in mapping are areas of Passcreek soils that make up about 5 percent of the acreage, areas of Slipman soils that make up about 5 percent, and areas of Sunup soils that make up about 5 percent.

Runoff is rapid, and the hazard of erosion is severe.

Soils of this association are used for woodland, wildlife habitat, and watershed. The understory vegetation provides some grazing for livestock and wild game. Dominant tree species on the Bayerton soil is ponderosa pine. Woodland production includes sawtimber, posts, and poles. Access is limited. The Bayerton part of this complex is in woodland group 3. (Bayerton soil in capability unit VIe–2, dryland; not in a range site. Tolman soil in capability unit VIIe–14, dryland, and Shallow Loamy range site, 15 to 19 inch precipitation zone. Rock land in capability unit VIIIs–83; not in a range site)

Bidman Series

The Bidman series consists of sloping, well-drained soils. These soils formed in alluvium. They are on foot slopes, mainly in the area of Ninemile Creek. Slopes range from 6 to 10 percent. Elevations range from 4,500 to 5,000 feet. The average annual precipitation is 10 to 14 inches, the average annual soil temperature is 50° to 51° F., and the frost-free season is 100 to 110 days. The vegetation is western wheatgrass, big sagebrush, and needle-and-thread.

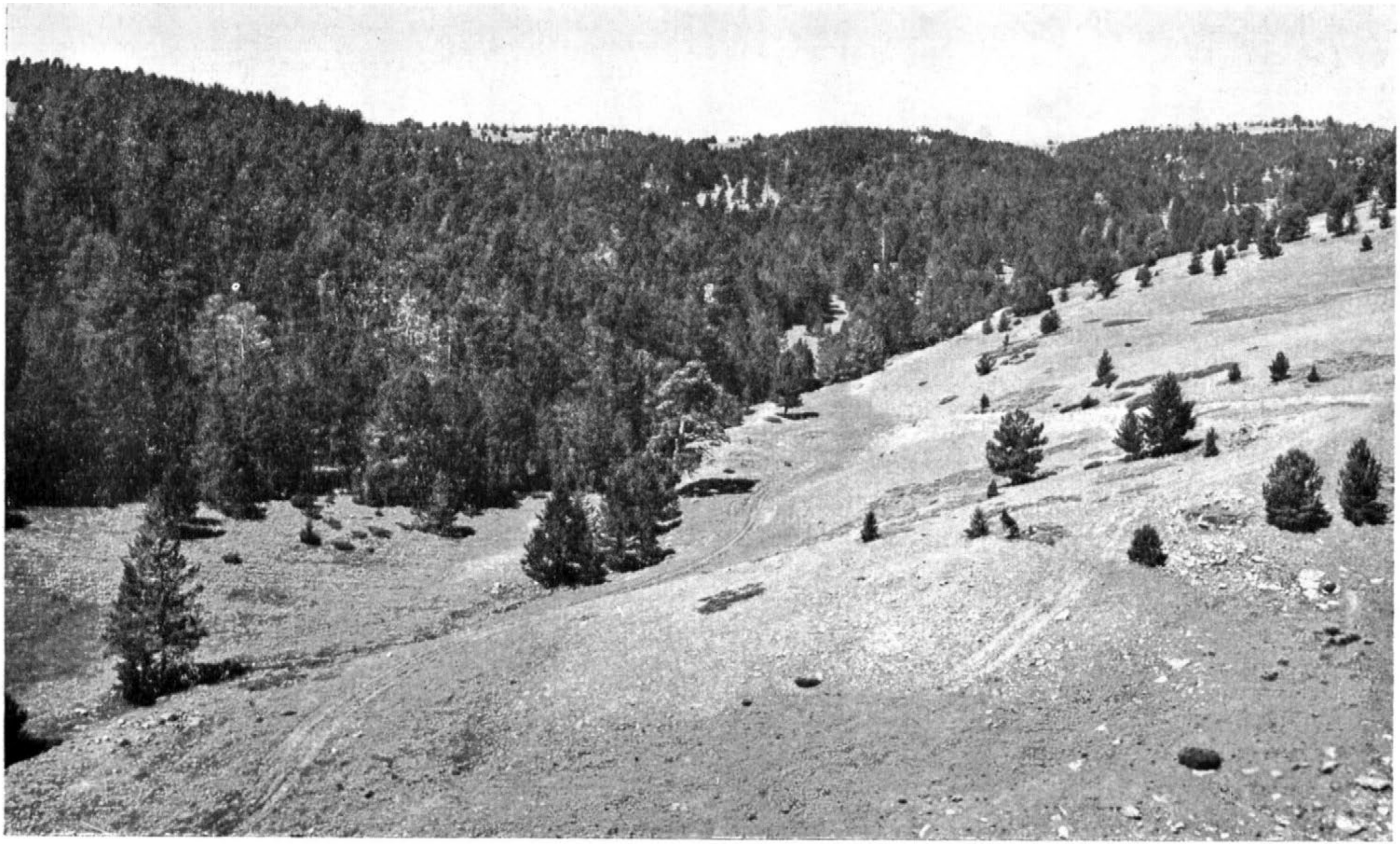

Figure 5.—Forrested area of Bayerton-Tolman association.

In a representative profile the surface layer is light brownish-gray, slightly acid loam about 5 inches thick. The upper part of the subsoil is brown, mildly alkaline clay about 13 inches thick, and the lower part is light yellowish-brown, moderately alkaline clay loam about 8 inches thick. The substratum is light olive-brown, strongly alkaline clay loam that reaches to a depth of 60 inches or more.

Permeability is moderately slow, and the available water capacity is high. The effective rooting depth is 40 to 60 inches or more.

These soils are used for range.

Representative profile of Bidman loam, in an area of Briggsdale-Bidman complex, rolling, near the east quarter corner of sec. 19, T. 46 N., R. 80 W.

A2—0 to 5 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak, thin, platy structure parting to very fine granular; soft, very friable; sand grains are clean and bleached; slightly acid; abrupt, smooth boundary.

B2t—5 to 18 inches, brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; strong, medium, prismatic structure parting to strong, medium, angular blocky; hard, very plastic; moderately thick, continuous, waxlike coatings on ped faces; waxlike coatings and fillings on inside of root channels and pores; a few streaks of bleached sand grains in the upper 2 inches; mildly alkaline; clear, wavy boundary.

B3ca—18 to 26 inches, light yellowish-brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; weak, coarse, prismatic structure parting to moderate, coarse, angular and subangular blocky; hard, very friable; peds are extremely hard; thin waxlike patches on ped faces; some secondary calcium carbonate occurring as soft concretions and in thin seams and streaks; strong effervescence; moderately alkaline; gradual, wavy boundary.

Cca—26 to 60 inches, light olive-brown (2.5Y 5/3) clay loam, olive brown (2.5Y 4/3) moist; massive; hard, very friable; secondary calcium carbonate occurring as soft concretions; strong effervescence; strongly alkaline.

Depth to bedrock ranges from 40 to 60 inches or more, and depth to calcareous material ranges from 11 to 20 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 2 percent. In some places a thin A1 horizon overlies the A2 horizon.

The A2 horizon ranges from 2.5Y to 10YR in hue, is 6 or 7 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It is slightly acid or neutral. In most places the primary structure is platy, but in some places it is granular. This horizon is soft or slightly hard when dry.

The B2t horizon ranges from 2.5Y to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It is neutral or mildly alkaline. In most places the primary structure is prismatic, but in some places it is columnar or angular blocky. It generally has texture of clay, but in some places it is clay loam. More than 15 percent of the sand fraction is fine sand or coarser.

The Cca horizon ranges from 5Y to 10YR in hue. It is moderately alkaline or strongly alkaline. The calcium carbonate equivalent ranges from 6 to 14 percent. This horizon has texture of clay loam or loam.

Bidman soils are mapped in a complex with Briggsdale soils.

Big Horn Series

The Big Horn series consists of nearly level to gently sloping, well-drained soils. These soils formed in alluvi-

um on high terraces on the mesa near Mayoworth. Slopes range from 0 to 6 percent. Elevations range from 5,000 to 5,500 feet. The average annual precipitation is 12 to 14 inches, the average annual soil temperature is 50° to 51° F., and the frost-free season is 95 to 110 days. The vegetation is western wheatgrass, green needlegrass, and big sagebrush.

In a representative profile the surface layer is grayish-brown, neutral loam about 4 inches thick. The upper part of the subsoil is grayish-brown, mildly alkaline clay about 18 inches thick, and the lower part is light brownish-gray, moderately alkaline clay loam about 4 inches thick. The substratum is light-gray or grayish-brown, moderately alkaline gravelly clay loam that reaches to a depth of 60 inches or more.

Permeability is moderately slow, and the available water capacity is high. The effective rooting depth is 60 inches or more.

These soils are used for range and wildlife habitat.

Representative profile of Big Horn loam, in an area of Big Horn-Wolf association, in the NW¼NW¼ sec. 4, T. 45 N., R. 82 W.

A1—0 to 4 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; moderate, fine, granular structure; soft, very friable; neutral; abrupt, smooth boundary.

B21t—4 to 9 inches, grayish-brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; strong, medium, prismatic structure parting to strong, fine, angular blocky; slightly hard, friable, very plastic; peds are extremely hard; waxlike coatings on ped faces; waxlike fillings in root channels and pores; thin, patchy, gray coatings on some ped faces in the upper inch; mildly alkaline; gradual, smooth boundary.

B22t—9 to 22 inches, grayish-brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; medium prismatic structure parting to strong, medium, angular blocky; slightly hard, friable, very plastic; peds are extremely hard; thick, continuous, waxlike coatings on ped faces; waxlike fillings in root channels and pores; mildly alkaline; 5 percent gravel; gradual, smooth boundary.

B3ca—22 to 26 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate, coarse, prismatic structure parting to moderate, coarse, angular and subangular blocky; hard, firm, plastic; peds are extremely hard; common, thin, glossy patches on ped faces and glossy coatings in root channels; 10 percent gravel; visible accumulation of calcium carbonate occurring as concretions and in thin seams and streaks; strong effervescence; moderately alkaline; gradual, smooth boundary.

C1ca—26 to 40 inches, light-gray (2.5Y 7/2) gravelly clay loam, light brownish gray (2.5Y 6/2) moist; massive or very weak, coarse, subangular blocky structure; very hard, firm, plastic; much visible secondary calcium carbonate occurring as concretions and in thin seams and streaks as well as in finely divided forms; calcium carbonate equivalent is 20 percent; 25 percent gravel; strong effervescence; moderately alkaline; gradual, smooth boundary.

C2ca—40 to 60 inches, grayish-brown (2.5Y 5/2) gravelly clay loam, dark grayish brown (2.5Y 4/2) moist; massive; hard, friable; some visible secondary calcium carbonate, but less than in the C1ca horizon; 25 percent gravel; strong effervescence; moderately alkaline.

Depth to calcareous material ranges from 12 to 30 inches, and thickness of the solum ranges from 15 to 40 inches. These soils, in some places, have a thin A2 horizon immediately above the B2t horizon. Content of coarse fragments ranges from 0 to 15 percent in the solum, but below the solum, it increases as depth increases.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 5 or 6 in value when dry and 3 or 4 when moist, and is 2 or 3 in chroma when dry or moist. Where the value of the A horizon is as dark as 5 when dry and 8 when moist, the horizon is less than 5 inches thick. This horizon is neutral or mildly alkaline. In most places the primary structure is granular, but in some places it is platy. This horizon ranges from soft to slightly hard when dry.

The B2t horizon ranges from 2.5Y to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 2 or 3 in chroma when dry or moist. It is neutral or mildly alkaline. It generally has texture of clay, but content of clay ranges from 35 to 50 percent.

The C horizon ranges from 2.5Y to 10YR in hue. It is moderately alkaline or strongly alkaline.

Big Horn-Wolf association (BN).—This association is about 45 percent Big Horn loam, 0 to 6 percent slopes, and about 30 percent Wolf loam, 0 to 6 percent slopes. The Big Horn soil has the profile described as representative of the Big Horn series. The Big Horn soil is on nearly level benches, and the Wolf soil is on nearly level to gently sloping high terraces.

Included with these soils in mapping are areas of Cragola soils that make up about 10 percent of the acreage, areas of Bone soils that make up 10 percent, and areas of Limon soils that make up about 5 percent.

Runoff is medium, and the hazard of erosion is moderate.

Soils of this association are used for range and wildlife habitat. (Capability unit IVe-2, dryland. Big Horn soil in Clayey range site, 10 to 14 inch precipitation zone, and Wolf soil in Loamy range site, 10 to 14 inch precipitation zone)

Bone Series

The Bone series consists of nearly level to sloping, moderately well drained soils. These soils formed in alluvium derived from alkaline shale. They are on alluvial fans. Slopes range from 0 to 10 percent. Elevations range from 4,500 to 5,000 feet. The average annual precipitation is 10 to 14 inches, the average annual soil temperature is about 51° F., and the frost-free season is 100 to 120 days. The vegetation is birdfoot sagebrush.

In a representative profile the surface layer is light-gray, moderately alkaline loam about one-half inch thick. The subsoil is brown, very strongly alkaline silty clay about 2½ inches thick. The upper part of the substratum is grayish-brown, very strongly alkaline silty clay about 40 inches thick, and the lower part is pale-brown, moderately alkaline silty clay loam that reaches to a depth of 60 inches or more.

Permeability is very slow, and the available water capacity is moderate. The effective rooting depth is 60 inches or more.

These soils are used for range and wildlife habitat.

Representative profile of a Bone soil, in an area of Petrie-Bone association, in the NW¼NW¼ sec. 4, T. 45 N., R. 82 W.

A2—0 to ½ inch, light-gray (10YR 7/1) loam, dark grayish (10YR 4/2) moist; thin porous crust; slightly hard, friable, slightly sticky and slightly plastic; moderately alkaline; abrupt, smooth boundary.

B2tsa—½ inch to 3 inches, brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; weak, fine, columnar structure parting to weak, very fine, subangular blocky; columns capped with material from the A2 horizon; extremely hard, extremely firm, very sticky and very

plastic; many, coarse, distinct threads and nodules of soluble salts; no roots; very strongly alkaline; clear, smooth boundary.

C1sa—3 to 43 inches, grayish-brown (10YR 5/2) silty clay, dark grayish brown (10YR 4/2) moist; massive; extremely hard, extremely firm, very plastic and very sticky; moderately calcareous; many, coarse, distinct threads and nodules of soluble salts; no roots; noneffervescent; very strongly alkaline; gradual, wavy boundary.

C2sa—43 to 60 inches, pale-brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; massive; hard, firm, sticky and slightly plastic; many, fine and medium, distinct threads of soluble salts; no roots; slight effervescence; moderately alkaline.

The B2t and C horizons range from moderately alkaline to very strongly alkaline. In some profiles these soils are stratified below a depth of 40 inches. The B and C horizons range from 10YR to 2.5Y in hue, are 5 or 6 in value when dry and 4 or 5 when moist, and range from 2 to 4 in chroma when dry or moist.

Bone soils are mapped in complexes with Absted, Petrie, and Wyarno soils.

Briggsdale Series

The Briggsdale series consists of nearly level to moderately steep, well-drained soils. These soils formed in residuum weathered from sandstone and shale on uplands. Slopes range from 0 to 15 percent. Elevations range from 4,500 to 5,000 feet. The average annual precipitation is 10 to 14 inches, the average annual soil temperature is about 51° F., and the frost-free season is 105 to 110 days. The vegetation is western wheatgrass, blue grama, cactus, and big sagebrush.

In a representative profile the surface layer is light brownish-gray or grayish-brown, neutral very fine sandy loam or loam about 6 inches thick. The upper part of the subsoil is dark yellowish-brown, mildly alkaline clay loam about 10 inches thick, and the lower part is olive-colored, moderately alkaline silty clay about 8 inches thick. The substratum is light olive-gray, moderately alkaline silty clay loam that is underlain by soft shale at a depth of about 28 inches.

Permeability is moderately slow, and the available water capacity is moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range, dryland spring wheat, and wildlife habitat.

Representative profile of Briggsdale very fine sandy loam, in an area of Briggsdale-Worf association, rolling, 1/8 mile east of the northeast corner of Worf Homestead, in the SW1/4SW1/4 sec. 29, T. 45 N., R. 80 W.

A11—0 to 3 inches, light brownish-gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) moist; weak, fine, crumb structure; upper one-half inch has weak, thin, platy structure; loose, very friable, nonplastic and nonsticky; many roots; neutral; abrupt, smooth boundary.

A12—3 to 6 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist massive; porous; slightly hard, friable, slightly sticky and plastic; many roots; neutral; abrupt, smooth boundary.

B2t—6 to 16 inches, dark yellowish-brown (10YR 4/4) clay loam, dark grayish-brown (10YR 4/2) moist; strong, fine, prismatic structure breaking to strong, fine, angular blocky; thick continuous clay films; slighty hard, firm, slightly sticky and plastic; many roots; mildly alkaline; clear, smooth boundary.

B3ca—16 to 24 inches, olive (5Y 5/3) silty clay, olive (5Y 4/3) moist; moderate, fine, subangular blocky structure; thin patchy clay films; hard, very firm, very sticky and very plastic; strong effervescence; many large splotches of calcium carbonate; few roots; moderately alkaline; clear, irregular boundary.

C1ca—24 to 28 inches, light olive-gray (5Y 6/2) silty clay loam, olive (5Y 5/4) moist; weak, very fine, subangular blocky structure; many olive-gray shale chips, 1/8 inch in diameter, embedded in matrix; slightly hard, firm, sticky and plastic; violent effervescence; no roots to very few roots; moderately alkaline; clear, irregular boundary.

C2—28 inches, soft, olive-colored, calcareous shale.

Depth to bedrock ranges from 20 to 40 inches, depth to calcareous material ranges from 12 to 18 inches, and thickness of the solum ranges from 16 to 24 inches. Content of coarse fragments typically is less than 5 percent.

The A horizon ranges from 10YR to 2.5Y in hue, ranges from 4 to 6 in value when dry and from 3 to 5 when moist, and is 2 or 3 in chroma when dry or moist. Where the horizon has a value as dark as 5 when dry and 3 when moist, it is only 2 to 4 inches thick. This horizon is neutral or mildly alkaline.

The B2t horizon ranges from 10YR to 2.5Y in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 3 or 4 in chroma when dry and 2 or 3 when moist. It has texture of clay loam or clay and is neutral or mildly alkaline.

The C horizon ranges from 2.5Y to 5Y in hue. It is moderately alkaline or strongly alkaline.

Briggsdale sandy loam, 0 to 6 percent slopes (BoB).—This soil is on uplands, mainly on hillsides, below ridge crests but above alluvial fans. It has a profile similar to the one described as representative of the series, except that the surface layer is sandy loam about 5 to 7 inches thick.

Included with this soil in mapping are small areas of Lohsman, Renohill, and Cushman soils.

Runoff is slow to medium, and the hazard of water erosion is slight to moderate. If the soil is left bare, the hazard of wind erosion is high.

This soil is used mainly for dryland spring wheat and for range. (Capability unit IVe-2, dryland; Loamy range site, 10 to 14 inch precipitation zone)

Briggsdale sandy loam, 6 to 10 percent slopes (BoC).—This soil is on the lower parts of rolling uplands. It has a profile similar to the one described as representative of the series, except that the surface layer is sandy loam about 6 inches thick.

Included with this soil in mapping are small areas of Cushman, Renohill, and Worf soils.

Runoff is medium to rapid, and the hazard of water erosion is moderate to high. The hazard of wind erosion is high.

This soil is used for range. (Capability unit VIe-2, dryland; Loamy range site, 10 to 14 inch precipitation zone)

Briggsdale-Bidman complex, rolling (BRD).—This complex is about 40 percent Briggsdale very fine sandy loam, 6 to 10 percent slopes; about 20 percent Bidman loam, 6 to 10 percent slopes; and about 20 percent Absted very fine sandy loam, 6 to 10 percent slopes. The Bidman soil has the profile described as representative of the Bidman series. The Briggsdale soil is on the upper parts of rolling uplands. The Bidman and Absted soils are intermingled in a complex pattern on hillsides and foot slopes below the Briggsdale soil.

Included with these soils in mapping are areas of Renohill soils that make up about 10 percent of the acreage. Also included are areas of Bone soils that make

up about 5 percent and areas of Worf soils that make up about 5 percent.

Runoff is medium to rapid, and the hazard of water erosion is moderate to high. If the vegetation is destroyed, the hazard of wind erosion is moderate to high.

Soils of this complex are used for range. (Capability unit VIe–2, dryland; Loamy range site, 10 to 14 inch precipitation zone)

Briggsdale-Lohsman complex, rolling (BSD).—This complex is about 40 percent Briggsdale very fine sandy loam, 6 to 10 percent slopes; about 25 percent Lohsman fine sandy loam, 6 to 10 percent slopes; and about 20 percent Cadoma silty clay loam, 6 to 10 percent slopes. The Lohsman and Cadoma soils have the profiles described as representative of the Lohsman and Cadoma series. The Lohsman and Briggsdale soils are intermingled in a complex pattern on rolling hillsides. The Cadoma soil is on the upper parts of hillsides.

Included with these soils in mapping, in the area of Ninemile Creek, are some areas of the Briggsdale-Lohsman complex that have slopes of 10 to 14 percent. Also included are areas of Renohill soils that make up about 10 percent of the acreage and areas of Absted soils that make up about 5 percent.

Runoff is medium to rapid on the Briggsdale and Lohsman soils and rapid on the Cadoma soil. The hazard of erosion is moderate to high on the Briggsdale and Lohsman soils and high on the Cadoma soil. If the cover is destroyed, the hazard of wind erosion is high on these soils.

Soils of this complex are used for range and wildlife habitat. (Capability unit VIe–2, dryland. Briggsdale and Lohsman soils in Loamy range site, 10 to 14 inch precipitation zone, and Cadoma soil in Dense Clay range site, 10 to 14 inch precipitation zone)

Briggsdale-Pugsley association (BT).—This association is about 30 percent Briggsdale very fine sandy loam, 6 to 15 percent slopes; about 25 percent Pugsley sandy loam, 6 to 15 percent slopes; and about 20 percent Renohill clay loam, 6 to 20 percent slopes. The Pugsley soil has the profile described as representative of the Pugsley series. These soils occupy rolling to hilly uplands. Generally, the Briggsdale soil is on the lower hillsides, the Renohill soil is above the Briggsdale soil on the upper hillsides, and the Pugsley soil is in the uppermost areas on rolling ridges.

Included with these soils in mapping are areas of Shingle soils that make up about 10 percent of the acreage and areas of Worf soils that make up about 10 percent. Also included are areas of Southfork soils that make up about 5 percent.

Runoff is medium to rapid, and the hazard of water erosion is moderate to high. If the cover is destroyed, the hazard of wind erosion is high on the Briggsdale and Pugsley soils.

Soils of this association are used for range and wildlife habitat. (Briggsdale soil in capability unit VIe–2, dryland; and Pugsley soil in capability unit VIe–5, dryland; Briggsdale and Pugsley soils in Loamy range site, 10 to 14 inch precipitation zone. Renohill soil in capability unit VIe–1, dryland, and Clayey range site, 10 to 14 inch precipitation zone)

Briggsdale-Renohill association (BU).—This association is about 45 percent Briggsdale very fine sandy loam, 6 to 15 percent slopes, and about 30 percent Renohill clay loam, 6 to 20 percent slopes. These soils occupy rolling to hilly uplands. The Briggsdale soil is on the lower hillsides, and the Renohill soil is on the upper hillsides.

Included with these soils in mapping are areas of Maysdorf soils that make up about 15 percent of the acreage, areas of Worf soils that make up about 10 percent, and areas of Shingle soils that make up about 5 percent. In T. 45 N., R. 82 W., Maysdorf soils make up about 25 percent of the association.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. If the cover is destroyed, the hazard of wind erosion is high on the Briggsdale soil.

Soils of this association are used for range and wildlife habitat. (Briggsdale soil in capability unit VIe–2, dryland, and Loamy range site, 10 to 14 inch precipitation zone. Renohill soil in capability unit VIe–1, dryland, and Clayey range site, 10 to 14 inch precipitation zone)

Briggsdale-Worf association, rolling (BWD).—This association is about 40 percent Briggsdale very fine sandy loam, 6 to 10 percent slopes, and about 30 percent Worf loam, 6 to 20 percent slopes. These soils have the profiles described as representative of the Briggsdale and Worf series. They occupy rolling uplands. The Briggsdale soil is on valley slopes and the lower hillsides, and the Worf soil is on the upper hillsides and ridges.

Included with these soils in mapping are areas of Orella soils that make up about 15 percent of the acreage, areas of Renohill soils that make up about 10 percent, and areas of Shingle soils that make up about 5 percent.

Runoff is medium to rapid, and the hazard of water erosion is moderate to high. If the cover is destroyed, the hazard of wind erosion is high on the Briggsdale soil.

Soils of this associaiton are used for range and wildlife habitat. (Briggsdale soil in capability unit VIe–2, dryland, and Loamy range site, 10 to 14 inch precipitation zone. Worf soil in capability unit VIIe–14, dryland, and Shallow Loamy range site, 10 to 14 inch precipitation zone)

Briggsdale-Worf association, hilly (BWE).—This association is about 40 percent Briggsdale very fine sandy loam, 10 to 15 percent slopes, and about 30 percent Worf loam, 10 to 30 percent slopes. These soils have the profiles described as representative of the Briggsdale and Worf series, except that the Briggsdale soil has a thinner surface layer and subsoil. These soils occupy hilly uplands. The landscape in many places is long, hilly uplands that are elongated from east to west and are dissected by deep drainageways. The Briggsdale soil is on the lower hillsides and in valleys, and the Worf soil is on the upper hillsides and ridges.

Included with these soils in mapping are areas of a deep sandy loam soil that is similar to Embry soils and makes up about 20 percent of the acreage, and areas of Travessilla soils that make up about 10 percent.

Runoff is rapid, and the hazard of water erosion is high. If the cover is destroyed, the hazard of wind erosion is high on the Briggsdale soil.

Soils of this association are used for range and wildlife habitat. (Briggsdale soil in capability unit VIe–2, dryland, and Loamy range site, 10 to 14 inch precipita-

tion zone. Worf soil in capability unit VIIe–14, dryland, and Shallow Loamy range site, 10 to 14 inch precipitation zone)

Burgess Series

The Burgess series consists of moderately steep, well-drained soils. These soils formed in residuum weathered from granite on ridges and hillsides in the mountains. Slopes range from 10 to 20 percent. Elevations range from 8,000 to 10,000 feet. The average annual precipitation is 15 to 19 inches, the average annual soil temperature is 40° F., and the average summer soil temperature is about 54° F. The frost-free season is 60 to 65 days, although frost can occur during any month. The vegetation is mountain grasses and sedges, but Idaho fescue is dominant.

In a representative profile the surface layer is dark grayish-brown or dark-brown, medium acid gravelly coarse sandy loam about 9 inches thick. The subsoil is brown or yellowish-brown, medium acid gravelly coarse sandy loam about 12 inches thick. The substratum is yellowish-brown, medium acid gravelly loamy coarse sand about 9 inches thick. This material is underlain by granite bedrock at a depth of about 30 inches.

Permeability is moderately rapid, and the available water capacity is low to moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Burgess gravelly coarse sandy loam, in an area of Hazton-Burgess association, a short distance north of the soil survey area, in the SW¼NE¼ sec. 23, T. 47 N., R. 85 W.

A1—0 to 4 inches, dark grayish-brown (10YR 4/2) gravelly coarse sandy loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, granular structure; soft, very friable; 20 percent fine and very fine, angular, granite pebbles; many grass roots; medium acid; clear, smooth boundary.

A3—4 to 9 inches, dark-brown (10YR 4/3) gravelly coarse sandy loam, dark brown (10YR 3/3) moist; weak, medium, subangular blocky structure parting to moderate, fine, granular; slightly hard, very friable; 20 percent fine and very fine, angular, granite pebbles; medium acid; clear, smooth boundary.

B2t—9 to 17 inches, brown (10YR 5/3) gravelly coarse sandy loam, dark brown (10YR 4/3) moist; moderate, coarse, subangular blocky structure; very hard, very friable; peds are extremely hard; thin, glossy, waxlike patches on ped faces; waxlike coatings on inside of root channels; waxlike bridgings between sand grains; 25 percent fine and very fine, angular, granite pebbles; medium acid; clear, smooth boundary.

B3—17 to 21 inches, yellowish-brown (10YR 5/4) gravelly coarse sandy loam, dark yellowish brown (10YR 4/4) moist; weak, coarse, subangular blocky structure; very hard, very friable; peds are extremely hard; a a few glossy patches on ped faces and a few waxlike bridges between sand grains; 25 percent fine and very fine, angular, granite pebbles; medium acid; gradual, wavy boundary.

C—21 to 30 inches, yellowish-brown (10YR 5/4) gravelly loamy coarse sand, dark yellowish brown (10YR 4/4) moist; single grained; hard, loose 25 percent fine and very fine, angular, granite pebbles; medium acid; diffuse, wavy boundary.

R—30 inches, granite bedrock.

Depth to bedrock ranges from 20 to 40 inches, and thickness of the solum ranges from 15 to 21 inches. These soils are medium acid or slightly acid throughout. Content of coarse fragments ranges from 15 to 35 percent. The fragments are mainly fine and very fine, angular, granite pebbles.

The A1 horizon ranges from 2.5Y to 7.5YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. This horizon is soft to slightly hard when dry.

The B2t horizon ranges from 2.5Y to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. In most places its primary structure is coarse subangular blocky or prismatic. It generally has texture of gravelly coarse sandy loam, but content of clay ranges from about 5 to 18 percent. The B2t horizon is 3 to 7 percent more clay than either the A3 horizon or the B3 horizon.

The C horizon ranges from 2.5Y to 7.5YR in hue. It has texture of gravelly loamy coarse sand or coarse sand.

Burgess soils are mapped in an association with Hazton soils.

Cadoma Series

The Cadoma series consists of gently sloping to moderately steep, well-drained soils. These soils formed in residuum weathered from alkaline shale on ridges and hillsides. Slopes range from 3 to 20 percent. Elevations range from 4,500 to 5,000 feet. The average annual precipitation is 10 to 14 inches, the average annual soil temperature is about 50° F., and the frost-free season is 105 to 110 days. The vegetation is birdfoot sagebrush, woody aster, and phlox.

In a representative profile the surface layer is light brownish-gray, strongly alkaline silty clay loam about 4 inches thick. The subsoil is light yellowish-brown, very strongly alkaline silty clay about 14 inches thick. The substratum is light brownish-gray, very strongly alkaline silty clay about 6 inches thick that is underlain by soft clay shale at a depth of about 24 inches.

Permeability is very slow, and the available water capacity is low. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Cadoma silty clay loam, in an area of Briggsdale-Lohsman complex, rolling, one-half mile south of the Crazy Woman VORTAC facility in Johnson County, in the SE¼SE¼ sec. 35, T. 46 N., R. 80 W.

A1—0 to 4 inches, light brownish-gray (2.5Y 6/2) silty clay loam, dark grayish brown (2.5Y 4/2) moist; strong, fine, granular structure; slightly hard, very friable, very plastic; strong effervescence; strongly alkaline; gradual, smooth boundary.

B2—4 to 18 inches, light yellowish-brown (2.5Y 6/4) silty clay, olive brown (2.5Y 4/4) moist; moderate, coarse, prismatic structure parting to moderate, medium, angular blocky; hard, firm, very plastic; peds are extremely hard; a few, thin, glossy patches on ped faces; strong effervescence; very strongly alkaline; clear, smooth boundary.

C1ca—18 to 24 inches, light brownish-gray (2.5Y 6/2) silty clay, dark grayish brown (2.5Y 4/2) moist; massive; extremely hard, very firm, very plastic; some visible secondary calcium carbonate occurring as concretions and in small crystals; strong effervescence; very strongly alkaline; gradual, wavy boundary.

C2—24 inches, dark-gray, gypsiferous, calcareous clay shale.

Depth to bedrock ranges from 20 to 40 inches, depth to calcareous material ranges from 0 to 4 inches, and thickness of the solum ranges from 10 to 24 inches. Content of exchangeable sodium ranges from 15 to 25 percent in the B2 and C horizons. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges

from 2 to 4 in chroma when dry and is 2 or 3 when moist. It ranges from moderately alkaline to very strongly alkaline. In most places its primary structure is granular, but in some places it is subangular blocky. This horizon ranges from soft to slightly hard when dry.

The B2 horizon ranges from 2.5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 5 in chroma when dry or moist. It is strongly alkaline or very strongly alkaline. In most places its primary structure is prismatic, but in some places it is angular blocky. Texture of the B2 and C1 horizons is silty clay or clay.

The C horizon ranges from 5Y to 10YR in hue. It is strongly alkaline or very strongly alkaline. This horizon generally has a concentration of secondary calcium sulfate as small crystals.

Cadoma soils are mapped in associations with Briggsdale, Gaynor, Limon, Lohsman, and Samsil soils.

Carnero Series

The Carnero series consists of moderately steep to steep, well-drained soils. These soils formed in residuum weathered from hard sandstone on mountain foothills. Slopes range from 10 to 30 percent. Elevations range from 5,800 to 6,500 feet. The average annual precipitation is 12 to 14 inches, the average annual soil temperature is about 48° F., and the frost-free season is 90 to 95 days. The vegetation is western wheatgrass, Idaho fescue, and ponderosa pine.

In a representative profile the surface layer is grayish-brown, mildly alkaline loam about 7 inches thick. The upper part of the subsoil is brown, mildly alkaline clay loam about 7 inches thick, and the lower part is light yellowish-brown, moderately alkaline clay loam about 6 inches thick. The substratum is light yellowish-brown, strongly alkaline gravelly clay loam about 6 inches thick that is underlain by hard sandstone at a depth of about 26 inches.

Permeability and the available water capacity are moderate. The effective rooting depth is 22 to 30 inches.

These soils are used for range and wildlife habitat.

Representative profile of Carnero loam, in an area of Sunup-Carnero association, in the SE¼SW¼ sec. 25, T. 45 N., R. 84 W.

A1—0 to 7 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, crumb structure; soft, very friable, slightly sticky and slightly plastic; many roots; mildly alkaline; gradual, wavy boundary.

B2t—7 to 14 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate, fine, subangular blocky structure; thin discontinuous clay films on ped faces; slightly hard, firm, sticky and plastic; few roots; mildly alkaline; clear, smooth boundary.

B3ca—14 to 20 inches, light yellowish-brown (10YR 6/4) clay loam, dark yellowish brown (10YR 4/4) moist; weak, fine, subangular blocky structure; thin discontinuous clay films; soft, friable, slightly sticky and slightly plastic; violent effervescence; few, fine, distinct threads and specks of secondary lime; moderately alkaline; clear, smooth boundary.

Cca—20 to 26 inches, light yellowish-brown (10YR 6/4) gravelly clay loam, yellowish brown (10YR 5/4) moist; massive; soft, friable, slightly sticky and slightly plastic; violent effervescence; many, fine, distinct threads and mottles of lime carbonate; many, but less than 35 percent, sandstone fragments 1 to 4 inches in diameter; strongly alkaline; gradual, wavy boundary.

R—26 inches, hard calcareous sandstone.

Depth to bedrock ranges from 22 to 30 inches, depth to carbonates ranges from 11 to 18 inches, and thickness of the solum ranges from 14 to 28 inches.

The A horizon ranges from 10YR to 7.5YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. The A and B horizons are neutral or mildly alkaline and may contain about 10 percent coarse fragments.

The B2t horizon ranges from about 24 to 35 percent in clay content. It ranges from 10YR to 7.5YR in hue, from 4 to 6 in value when dry and 3 to 5 when moist, and from 2 to 4 in chroma when dry or moist.

The Cca horizon is moderately alkaline or strongly alkaline. Content of coarse fragments in this horizon typically is 20 percent.

Carnero soils are mapped in an association with Sunup soils.

Cloud Peak Series

The Cloud Peak series consists of sloping to steep, well-drained soils. These soils formed in residuum weathered from limestone. They are on north-facing, timbered hillsides in the mountains. Slopes range from 6 to 30 percent. Elevations range from 7,800 to 9,000 feet. The average annual precipitation is 15 to 19 inches, the average annual soil temperature is 41° F., and the average summer soil temperature is about 54° F. The frost-free season is about 65 days, although frost can occur in any month. The vegetation is dominantly Douglas-fir, Engelmann spruce, and some lodgepole pine.

In a representative profile these soils have about 4 inches of forest litter over a surface layer of dark-brown, neutral silt loam about 1 inch thick. The subsurface layer is pinkish-gray, neutral very fine sandy loam about 3 inches thick. The upper part of the subsoil is brown, neutral stony silty clay loam about 14 inches thick and is about 60 percent limestone fragments and gravel; the lower part is brown, mildly alkaline stony loam about 4 inches thick. The substratum is brown, moderately alkaline stony loam about 10 inches thick that is underlain by limestone bedrock at a depth of about 32 inches.

Permeability is moderate, and the available water capacity is low to moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for woodland and limited grazing and as watershed.

Representative profile of Cloud Peak silt loam, in an area of Cloud Peak-Dell association, just south of the site of the old Flagle sawmill, in the SW¼ sec. 23, T. 45 N., R. 85 W.

O1—4 inches to 1 inch, undecomposed organic material, mainly remains of needles, twigs, bark, and grass.

O2—1 inch to 0, partly decomposed organic material, mainly remains of needles, twigs, bark, and grass.

A1—0 to 1 inch, dark-brown (10YR 4/3) silt loam, dark brown (10YR 3/3) moist; strong, fine, crumb structure; soft, very friable; 10 percent limestone rock; neutral; clear, smooth boundary.

A2—1 to 4 inches, pinkish-gray (7.5YR 6/2) very fine sandy loam, brown (7.5YR 5/2) moist; moderate, thin, platy structure parting to moderate, fine, granular; soft, very friable; 15 percent limestone fragments; neutral; clear, smooth boundary.

B2t—4 to 18 inches, brown (7.5YR 5/4) stony silty clay loam, dark brown (7.5YR 4/4) moist; moderate, fine and medium, subangular blocky structure; slightly hard, very friable; peds are very hard; thin, nearly continuous, waxlike coatings on ped faces; waxlike fillings in pores; 60 percent limestone fragments and gravel; neutral; gradual, wavy boundary.

B3—18 to 22 inches, brown (10YR 5/3) stony loam, dark brown (10YR 4/3) moist; weak, medium, subangular blocky structure; hard, very friable; peds are very hard; a few glossy patches on some ped faces; wax-like patches in some root channels; 60 percent limestone fragments and gravel; mildly alkaline; gradual, wavy boundary.

Cca—22 to 32 inches, brown (10YR 5/3) stony loam, dark brown (10YR 4/3) moist; massive; hard, very friable; 70 percent limestone fragments and gravel; some visible secondary calcium carbonate occurring as concretions and in thin seams and streaks as well as coatings on gravel-size fragments; strong effervescence; moderately alkaline; gradual, wavy boundary.

R—32 inches, hard, fractured limestone.

Depth to bedrock ranges from 20 to 40 inches, and thickness of the solum ranges from 15 to 40 inches. Content of coarse fragments below a depth of about 10 inches ranges from 35 to 70 percent. The calcium carbonate equivalent of the entire profile, including coarse fragments less than 3 inches diameter, typically ranges from 6 to 20 percent.

The A2 horizon ranges from 2.5Y to 7.5Y in hue, is 6 or 7 in value when dry and 5 or 6 when moist, and ranges from 2 to 4 in chroma when dry or moist. It is slightly acid or neutral. This horizon ranges from soft to slightly hard when dry.

The B2t horizon ranges from 2.5Y to 5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 3 or 4 in chroma when dry or moist. It is neutral or mildly alkaline. The matrix generally has a texture of silt loam or silty clay loam, but content of clay ranges from about 18 to 35 percent.

The Cca horizon ranges from 2.5Y to 7.5YR in hue. It is moderately alkaline or strongly alkaline. The calcium carbonate equivalent of the fine-earth part of this horizon ranges from 2 to 12 percent.

Cloud Peak-Dell association (CD).—This association is about 45 percent Cloud Peak silt loam, 6 to 30 percent slopes, and about 30 percent Dell loam, 6 to 20 percent slopes. These soils have the profiles described as representative of the Cloud Peak and Dell series. They occupy north- and east-facing, timbered hillsides. Generally, the Cloud Peak soils are on the upper parts of hillsides, and the Dell soils are on the lower parts of hillsides below the Cloud Peak soils.

Included with these soils in mapping are areas of shallow, stony, loamy soils that make up about 15 percent of the acreage and rock ledges that make up about 10 percent.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

Soils of this association are used for woodland and watershed and, to a minor extent, for grazing. The dominant tree species are Douglas-fir, Engelmann spruce, and some lodgepole pine in burned-over areas. Woodland production includes sawtimber, posts, and poles. Soils of this association are in woodland group 1. (Cloud Peak soil in capability unit VIs–9, dryland; not in a range site. Dell soil in capability unit VIe–2, dryland; not in a range site)

Colluvial Land

Colluvial land (CE) consists of rock fragments and soil materials at the base of steep to very steep rock outcrops. Slopes range from 30 to more than 60 percent. Areas of this land type are mainly in the mountains. The vegetation is sparse and is scattered pine trees and bluebunch wheatgrass.

Colluvial land is used as wildlife habitat. (Capability unit VIIs–9, dryland; not in a range site)

Connerton Series

The Connerton series consists of nearly level to steep, well-drained soils. These soils formed in reddish-colored alluvium. They are on alluvial fans and colluvial foot slopes. Slopes range from 0 to 30 percent. Elevations range from 5,000 to 5,500 feet. The average annual precipitation is 10 to 14 inches, the average annual soil temperature is about 49° F., and the frost-free season is 100 to 105 days. The vegetation is western wheatgrass, blue grama, needle-and-thread, and big sagebrush.

In a representative profile, these soils are reddish-brown, moderately alkaline loam that reaches to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is more than 60 inches.

These soils are used for range; for irrigated hay, pasture, and small grain; and as wildlife habitat.

Representative profile of Connerton loam, in an area of Connerton-La Fonda association, in the NE¼NE¼ sec. 11, T. 42 N., R. 84 W.

A1—0 to 8 inches, reddish-brown (5YR 5/3) loam, dark reddish brown (5YR 5/3) moist; moderate, very fine, granular structure; soft, very friable; strong effervescence; moderately alkaline; gradual, smooth boundary.

C—8 to 60 inches, reddish-brown (2.5YR 5/4) loam, reddish brown (2.5YR 4/4) moist; massive; hard, very friable; strong effervescence; moderately alkaline.

These soils generally are calcareous throughout, but in places they are leached in the uppermost 2 to 3 inches. Some profiles have a small accumulation of secondary calcium carbonate. Texture between depths of 10 and 40 inches generally is loam or clay loam, but content of clay ranges from 18 to 35 percent. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent.

The A1 horizon ranges from 7.5YR to 2.5YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. It ranges from mildly alkaline to strongly alkaline. In most places its primary structure is granular, but in some places it is crumb or subangular blocky. This horizon ranges from soft to slightly hard when dry.

The C horizon ranges from 5YR to 10R in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 4 or 5 in chroma when dry or moist. It is moderately alkaline or strongly alkaline. The calcium carbonate equivalent typically is less than 2 percent but ranges from less than 1 percent to about 5 percent.

Connerton silt loam, 0 to 3 percent slopes (CnA).—This soil is on alluvial fans. It has a profile similar to the one described as representative of the series, except that the surface layer is silt loam about 8 inches thick.

Included with this soil in mapping are areas of Connerton silt loam, wet, and La Fonda soils.

Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is high.

This soil is used for irrigated hay, pasture, and small grain and for range. (Capability units IVe–3, dryland, and IIe–3, irrigated; Loamy range site, 10 to 14 inch precipitation zone)

Connerton silt loam, 3 to 6 percent slopes (CnB).—This soil is on alluvial fans. It has a profile similar to the one described as representative of the series, except that the surface layer is silt loam 6 to 8 inches thick.

Included with this soil in mapping are some areas of Connerton soils that have slopes of less than 3 percent and some that have slopes of more than 6 percent. Also included are areas of La Fonda soils.

Runoff is medium, and the hazard of water erosion is moderate to high. The hazard of wind erosion is high.

This soil is used for irrigated hay, pasture, and small grain and for range. (Capability units IVe–3, dryland, and IIIe–3, irrigated; Loamy range site, 10 to 14 inch precipitation zone)

Connerton silt loam, 6 to 10 percent slopes (CnC).—This soil is on alluvial fans. It has a profile similar to the one described as representative of the series, except that the surface layer is silt loam 6 to 8 inches thick.

Included with this soil in mapping are small areas of Connerton silt loam, 10 to 30 percent slopes, and areas of Spearfish soils.

Runoff is rapid, and the hazard of water erosion is high. If the cover is destroyed, the hazard of wind erosion is high.

This soil is used for irrigated hay, pasture, and small grain and for range. (Capability units VIe–3, dryland, and IVe–3, irrigated; Loamy range site, 10 to 14 inch precipitation zone)

Connerton silt loam, 10 to 30 percent slopes (CnD).—This soil is on colluvial foot slopes. It has a profile similar to the one described as representative of the series, except that the surface layer is silt loam 6 to 7 inches thick.

Included with this soil in mapping are small areas of Spearfish soils and Rock outcrop.

Runoff is rapid, and the hazard of water erosion is high. If the cover is destroyed, the hazard of wind erosion is high.

This soil is used for range and wildlife habitat. (Capability unit VIe–3, dryland; Loamy range site, 10 to 14 inch precipitation zone)

Connerton silt loam, wet (Co).—This soil is on alluvial fans. It has a profile similar to the one described as representative of the series, except that it has a surface layer of silt loam about 8 inches thick and is moderately saline. Also it has a fluctuating water table that keeps the soil wet most of the time. The surface layer dries out late in fall or in winter. Slopes are 0 to 10 percent.

Included with this soil in mapping are areas of Connerton silt loam and areas of soils that have a very high content of gypsum.

Runoff is slow to rapid, and the hazard of water erosion is slight to high. The hazard of wind erosion is high.

This soil is used for irrigated pasture. (Capability units VIws–10, dryland, and IVws–10, irrigated; Saline Subirrigated range site, 10 to 14 inch precipitation zone)

Connerton-La Fonda association (CR).—This association is about 50 percent Connerton loam, 3 to 10 percent slopes, and about 30 percent La Fonda very fine sandy loam, 3 to 10 percent slopes. These soils have the profiles described as representative of the Connerton and La Fonda series. They occupy alluvial fans. The Connerton soil is on the upper parts of the fans, and the La Fonda soil is on the lower parts of the fans. This association occurs mainly in the Red Wall area near Barnum and Mayoworth.

Included with these soils in mapping are areas of Spearfish soils that make up about 10 percent of the acreage and areas of Barnum soils and Gullied land, each of which makes up about 5 percent.

Runoff is medium to rapid, and the hazard of water erosion is moderate to high. If the cover is destroyed, the hazard of wind erosion is high.

Soils of this association are used for range and wildlife habitat. (Connerton soil in capability unit VIe–3, dryland, and La Fonda soil in capability unit VIe–2, dryland. Both soils in Loamy range site, 10 to 14 inch precipitation zone).

Connerton-Spearfish association (CS).—This association is about 50 percent Connerton loam, 10 to 20 percent slopes, and 30 percent Spearfish very fine sandy loam, 10 to 30 percent slopes. These soils occupy moderately steep alluvial fans and colluvial foot slopes and moderately steep to steep ridges. The Connerton soil is on alluvial fans and colluvial foot slopes, and the Spearfish soil is on ridges.

Included with these soils in mapping are areas of soils that are similar to the Spearfish soil and that make up about 10 percent of the acreage. These soils differ from Spearfish soils in that they are less than 10 inches deep. Also included are areas of Rock outcrop that make up about 10 percent of the acreage.

Runoff is rapid, and the hazard of water erosion is high. If the cover is destroyed, the hazard of wind erosion is high.

Soils of this association are used for range and wildlife habitat. (Connerton soil in capability unit VIe–3, dryland, and Loamy range site, 10 to 14 inch precipitation zone. Spearfish soil in capability unit VIIe–14, dryland, and Shallow Loamy range site, 10 to 14 inch precipitation zone)

Cragola Series

The Cragola series consists of well-drained or somewhat excessively drained soils. These soils formed in gravelly loamy alluvium that was deposited over sandstone, siltstone, or shale. They are on ridge crests and ridges, mainly on the mesa near Mayoworth. Slopes range from 10 to 40 percent. Elevations range from 5,000 to 5,500 feet. The average annual precipitation is 12 to 14 inches, the average annual soil temperature is about 50° F., and the frost-free season is 105 to 110 days. The vegetation is bluebunch wheatgrass and threadleaf sedge.

In a representative profile the surface layer is light brownish-gray, moderately alkaline very gravelly loam about 4 inches thick. The underlying layer is pale-brown or light yellowish-brown, moderately alkaline very gravelly clay loam about 12 inches thick that is underlain by siltstone at a depth of about 16 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is 10 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Cragola very gravelly loam, in an area of Cragola-Shingle association, near the center of sec. 3, T. 45 N., R. 82 W.

A1—0 to 4 inches, light brownish-gray (10YR 6/2) very gravelly loam, dark grayish brown (10YR 4/2) moist; moderate, fine, granular structure; soft, very friable; 60 percent pebbles and cobblestones; strong effer-

vescence; moderately alkaline; clear, smooth boundary.

AC—4 to 8 inches, pale-brown (10YR 6/3) very gravelly clay loam, dark brown (10YR 4/3) moist; weak, fine, subangular blocky structure; slightly hard, very friable; 60 percent pebbles and cobblestones; strong effervescence; moderately alkaline; gradual, wavy boundary.

C1ca—8 to 16 inches, light yellowish-brown (10YR 6/4) very gravelly clay loam, yellowish brown (10YR 5/4) moist; massive; hard, very friable; 60 percent pebbles and cobblestones; some accumulation of visible secondary calcium carbonate occurring as soft concretions and as coatings on pebbles; strong effervescence; moderately alkaline; gradual, wavy boundary.

C2—16 inches, calcareous siltstone.

These soils generally are calcareous throughout, but in places they are leached in the uppermost 1 or 2 inches. Depth to bedrock ranges from 10 to 20 inches. Content of coarse fragments ranges from 35 to 80 percent. The fragments are mostly pebbles and cobblestones.

The A horizon ranges from 2.5Y to 7.5YR in hue, is 5 or 6 in value when dry and 3 or 4 when moist, and is 2 or 3 in chroma when dry or moist. Where the A horizon has a value as dark as 5 when dry and 3 when moist, it is less than 4 inches thick. This horizon ranges from mildly alkaline to strongly alkaline. In most places it has fine, granular structure, but in some places it has subangular blocky structure. This horizon ranges from soft to slightly hard when dry.

The Cca horizon ranges from 2.5Y to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 3 or 4 in chroma when dry or moist. It is moderately alkaline or strongly alkaline. The calcium carbonate equivalent typically ranges from about 1 to 6 percent. Content of visible secondary calcium carbonate varies from place to place, but in some places there is no evidence of accumulation.

Cragola-Ascalon association (CT).—This association is about 50 percent Cragola very gravelly loam, 10 to 30 percent slopes, and about 25 percent Ascalon fine sandy loam, 3 to 15 percent slopes. These soils occupy moderately steep to steep, gravel-capped ridges and foot slopes and gently sloping to moderately steep alluvial fans. The Cragola soil is on gravel-capped ridges, and the Ascalon soil is on foot slopes and alluvial fans.

Included with these soils in mapping are areas of Fort Collins soils that make up about 15 percent of the acreage. Also included are areas of Shingle soils that make up about 5 percent and areas of Ulm soils that make up about 5 percent.

Runoff is rapid on the Cragola soil and medium to rapid on the Ascalon soil. The hazard of erosion is high on the Cragola soil. The hazard of water erosion is moderate to high on the Ascalon soil, and if the cover is disturbed or destroyed, the hazard of wind erosion is high.

Soils of this association are used for range and wildlife habitat. (Cragola soil in capability unit VIIe-14, dryland, and Shallow Clayey range site, 10 to 14 inch precipitation zone. Ascalon soil in capability unit VIe-5, dryland, and Loamy range site, 10 to 14 inch precipitation zone)

Cragola-Shingle association (CU).—This association is about 50 percent Cragola very gravelly loam, 10 to 40 percent slopes, and about 30 percent Shingle loam, 10 to 40 percent slopes (fig. 6). The Cragola soil has the profile described as representative of the Cragola series. These soils occupy uplands. The Cragola soil is on gravel-capped ridges and ridge crests, and the Shingle soil is on ridge crests and hillsides that are free of any gravel mantle.

Included with these soils in mapping are gravel beds that make up about 10 percent of the acreage. Also included are areas of Rock outcrop that make up about 5 percent and areas of Worf soils that make up about 5 percent.

Runoff is rapid, and the hazard of erosion is high.

Soils of this association are used for range and wildlife habitat. (Capability unit VIIe-14, dryland. Cragola soil in Shallow Clayey range site, 10 to 14 inch precipitation zone, and Shingle soil in Shallow Loamy range site, 10 to 14 inch precipitation zone)

Cushman Series

The Cushman series consists of sloping and moderately steep, well-drained soils. These soils formed in residuum weathered from sandstone and siltstone on uplands. Slopes range from 6 to 20 percent. Elevations range from 4,500 to 5,000 feet. The average annual precipitation is 10 to 14 inches, the average annual soil temperature is about 50° F., and the frost-free season is 100 to 110 days. The vegetation is blue grama, big sagebrush, western wheatgrass, and cactus.

In a representative profile the surface layer is light brownish-gray, neutral fine sandy loam or loam about 4 inches thick. The upper part of the subsoil is yellowish-brown or brown, mildly alkaline clay loam about 11 inches thick, and the lower part is light yellowish-brown, moderately alkaline clay loam about 6 inches thick. The substratum is pale-olive, strongly alkaline sandy loam, about 9 inches thick, that is underlain by soft sandstone at a depth of about 30 inches.

Permeability is moderate, and the available water capacity is low to moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Cushman fine sandy loam, in an area of Cushman-Briggsdale association, in the NW¼NW¼ sec. 11, T. 45 N., R. 78 W.

A11—0 to 2 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; moderate, fine, crumb structure; soft, very friable; many roots; neutral; clear, smooth boundary.

A12—2 to 4 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak, thin, platy structure parting to moderate, medium, crumb; soft, very friable; many roots; neutral; abrupt, smooth boundary.

B21t—4 to 10 inches, yellowish-brown (10YR 5/4) clay loam, dark brown (10YR 4/3) moist; weak, coarse, prismatic structure parting to moderate, medium, angular blocky; thin discontinuous clay films; slightly hard, friable; slightly sticky and slightly plastic; few roots; mildly alkaline; clear, smooth boundary.

B22t—10 to 15 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; weak, coarse, subangular blocky structure; slightly hard, very friable, slightly sticky and nonplastic; few roots; mildly alkaline; abrupt, smooth boundary.

B3ca—15 to 21 inches, light yellowish-brown (2.5Y 6/3) clay loam, olive brown (2.5Y 4/4) moist; weak, coarse, subangular blocky structure; soft, very friable, slightly sticky and nonplastic; strong effervescence; many fine specks and threads of calcium carbonate; few roots; moderately alkaline; clear, smooth boundary.

C1ca—21 to 30 inches, pale-olive (5Y 6/3) sandy loam, olive (5Y 5/4) moist; massive; slightly hard, friable, slightly sticky; many fine specks and threads of

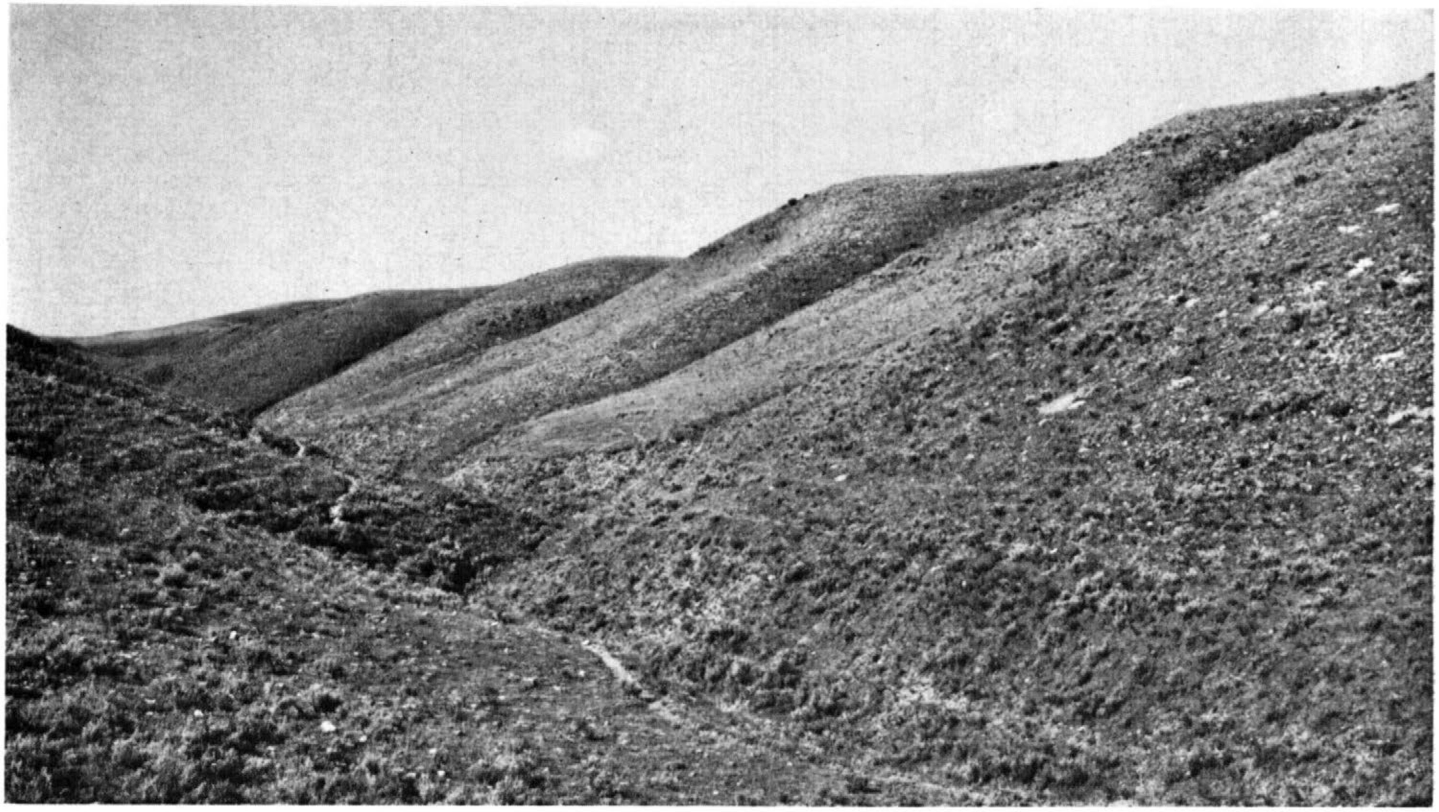

Figure 6.—**Area of Cragola-Shingle association along terrace margin of the mesa north of Mayoworth.**

calcium carbonate; violent effervescence; strongly alkaline; clear, smooth boundary.
C2—30 inches, soft calcareous sandstone.

Depth to bedrock ranges from 20 to 40 inches, and depth to calcareous material ranges from 12 to 18 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent.

The A horizon ranges from 2.5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist.

The B2t horizon ranges from 2.5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It is neutral or mildly alkaline. This horizon has texture of loam or clay loam.

The Cca horizon ranges from 5Y to 10YR in hue. It is moderately alkaline or strongly alkaline.

Cushman-Briggsdale association (CV).—This association is about 30 percent Cushman fine sandy loam, 6 to 20 percent slopes; about 25 percent Briggsdale very fine sandy loam, 6 to 15 percent slopes; and about 20 percent Renohill clay loam, 6 to 20 percent slopes. The Cushman soil has the profile described as representative of the Cushman series. These soils occupy rolling or hilly uplands. Generally, the Cushman soil is on convex hillsides, the Briggsdale soil is on concave hillsides, and the Renohill soil is on the upper ridges below the crests.

Included with these soils in mapping are areas of Shingle soils that make up about 15 percent of the acreage and areas of Worf soils that make up about 10 percent.

Runoff is medium to rapid, and the hazard of water erosion is moderate to high. If the cover is destroyed, the hazard of wind erosion is high on the Cushman and Briggsdale soils.

Soils of this association are used for range and as wildlife habitat. (Cushman and Briggsdale soils in capability unit VIe-2, dryland, and Loamy range site, 10 to 14 inch precipitation zone. Renohill soil in capability unit VIe-1, dryland, and Clayey range site, 10 to 14 inch precipitation zone)

Cushman-Embry association (CW).—This association is about 35 percent Cushman fine sandy loam, 6 to 20 percent slopes; about 25 percent Embry sandy loam, 6 to 20 percent slopes; and about 20 percent Julesburg sandy loam, 6 to 20 percent slopes. These soils occupy rolling or hilly uplands and alluvial foot slopes. The Cushman soil is on the upper ridges, the Embry soil is on alluvial foot slopes that are on the lee sides of ridges, and the Julesburg soil is on alluvial foot slopes.

Included with these soils in mapping are areas of Stoneham soils that make up about 15 percent of the acreage and areas of Travessilla soils that make up about 10 percent.

Runoff is medium to rapid, and the hazard of water erosion is moderate to high. If the cover is destroyed, the hazard of wind erosion is high.

Soils of this association are used for range and wildlife habitat. (Cushman soil in capability unit VIe-2, dryland, and Loamy range site, 10 to 14 inch precipitation zone. Embry and Julesburg soils in capability unit VIe-5, dryland, and Sandy range site, 10 to 14 inch precipitation zone)

Cushman-Terry association (CX).—This association is about 40 percent Cushman fine sandy loam, 6 to 20 percent slopes, and about 30 percent Terry fine sandy

loam, 6 to 15 percent slopes. These soils occupy rolling or hilly uplands.

Included with these soils in mapping are areas of Ascalon soils that make up about 15 percent of the acreage and areas of Tassel soils that make up about 15 percent and some small sandstone outcrops.

Runoff is medium to rapid, and the hazard of water erosion is moderate to high. If the cover is destroyed, the hazard of wind erosion is high.

Soils of this association are used for range and wildlife habitat. (Cushman soil in capability unit VIe-2, dryland, and Loamy range site, 10 to 14 inch precipitation zone. Terry soil in capability unit VIe-5, dryland, and Sandy range site, 10 to 14 inch precipitation zone)

Danko Series

The Danko series consists of well-drained soils. These soils formed in residuum weathered from alkaline shale on uplands. Slopes range from 10 to 30 percent. Elevations range from 4,500 to 5,200 feet. The average annual precipitation is 10 to 12 inches, the average annual soil temperature is about 51° F., and the frost-free season is 105 to 110 days. The vegetation is western wheatgrass.

In a representative profile the surface layer is brown, very strongly alkaline clay about 2 inches thick. The underlying layer is reddish-brown, very strongly alkaline clay, about 10 inches thick, that is underlain by shale at a depth of about 12 inches.

Permeability is slow, and the available water capacity is low. The effective rooting depth is 10 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Danko clay, in an area of Renohill-Danko association, near the center of sec. 22, T. 45 N., R. 80 W.

A1—0 to 2 inches, brown (7.5YR 5/4) clay, dark brown (7.5YR 4/4) moist; moderate, medium and fine, granular structure; slightly hard, friable, very plastic; strong effervescence; very strongly alkaline; abrupt, smooth boundary.

C1—2 to 12 inches, reddish-brown (5YR 5/4) clay, reddish brown (5YR 4/4) moist; massive; extremely hard, very firm, very plastic; strong effervescence; very strongly alkaline; gradual, wavy boundary.

C2—12 to 20 inches, calcareous, reddish-brown, strongly alkaline, shale bedrock.

Depth to bedrock ranges from 10 to 20 inches. Content of exchangeable sodium is more than 15 percent throughout. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent.

The A horizon ranges from 7.5YR to 5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 3 or 4 in chroma when dry or moist. In most places it has granular structure, but in some places it has subangular blocky structure. This horizon is soft or slightly hard when dry. The A and C horizons are strongly alkaline or very strongly alkaline.

The C horizon ranges from 5YR to 2.5YR in hue, is 5 or 6 in value when dry, and ranges from 3 to 5 in chroma when dry or moist.

Danko soils are mapped in an association with Renohill soils.

Decross Series

The Decross series consists of sloping or moderately steep, well-drained soils. These soils formed in alluvium derived from limestone. They are on alluvial fans. Slopes range from 6 to 15 percent. Elevations range from 7,500 to 9,000 feet. The average annual precipitation is 15 to 19 inches, the average annual soil temperature is about 40° F., the average summer soil temperature is about 54° F. The frost-free season is 65 to 70 days, although light frost can occur during any month. The vegetation is Idaho fescue, big sagebrush, and king fescue.

In a representative profile the surface layer is dark grayish-brown, neutral loam about 4 inches thick. The upper part of the subsoil is dark grayish-brown, neutral loam or clay loam about 26 inches thick, and the lower part is grayish-brown, neutral loam or clay loam about 7 inches thick. The substratum is light brownish-gray, moderately alkaline loam that reaches to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more.

These soils are used for range and wildlife habitat.

Representative profile of Decross loam, in an area of Decross-Woosley association, in the SE¼SE¼ sec. 22, T. 46 N., R. 85 W.

A1—0 to 4 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; strong, very fine, granular structure; soft, very friable; neutral; clear, smooth boundary.

B1—4 to 9 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure parting to moderate, medium, granular; slightly hard, very friable; a few glossy patches on ped faces; neutral; clear smooth boundary.

B2t—9 to 30 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, very friable; peds are very hard; many, thin, waxlike patches and seams on ped faces; waxlike coatings in root channels and pores; 5 percent limestone fragments; neutral; clear, wavy boundary.

B3ca—30 to 37 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, very friable; peds are hard; a few glossy patches on ped faces; some visible secondary calcium carbonate occurring as concretions and in thin seams; strong effervescence; moderately alkaline; 5 percent limestone fragments; gradual, wavy boundary.

Cca—37 to 60 inches, light brownish-gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; massive; hard, very friable; 5 percent limestone fragments; visible secondary calcium carbonate occurring as concretions, in thin seams and streaks, and as coatings on undersides of coarse fragments; strong effervescence; moderately alkaline.

Depth to calcareous material ranges from 16 to 40 inches, and thickness of the solum ranges from 20 to 50 inches. Content of coarse fragments ranges from 0 to 15 percent. The fragments mainly are small limestone fragments.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and ranges from 1 to 3 in chroma when dry or moist. It ranges from slightly acid to mildly alkaline. In most places its primary structure is granular or crumb, but in some places it is subangular blocky. This horizon is soft or slightly hard when dry.

The B2t horizon ranges from 2.5Y to 7.5YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. It is neutral or mildly alkaline. In most places its primary structure is prismatic, but in some places it is subangular blocky. It is typically loam or clay loam, but in some places it is sandy clay loam, and more than 15 percent but less than 35 percent of the sand is fine sand or coarser.

The Cca horizon ranges from 2.5Y to 10YR in hue. The calcium carbonate equivalent ranges from about 3 to 14 percent.

Decross-Woosley association (DE).—This association is about 40 percent Decross loam, 6 to 15 percent slopes; about 20 percent Woosley loam, 6 to 20 percent slopes; and about 20 percent Nathrop stony loam, 10 to 30 percent slopes (fig. 7). The Decross soil has the profile described as representative of the Decross series. These soils occupy valleys and ridges. The Decross soil is on the lower alluvial fans, the Woosley soil is above the Decross soils on hillsides, and the Nathrop soil is on ridges.

Included with these soils in mapping are areas of Laporte soils that make up about 15 percent of the acreage and narrow, stony-bottomed drainageways that make up about 5 percent.

Runoff is medium to rapid on the Decross and Woosley soils but rapid on Nathrop soils. The hazard of erosion is moderate to high on the Decross and Woosley soils but high on the Nathrop soil.

Soils of this association are used for range and wildlife habitat. (Decross and Woosley soils in capability unit VIe–2, dryland, and Loamy range site, 15 to 19 inch precipitation zone. Nathrop soil in capability unit VIs–9, dryland, and Coarse Upland range site, 15 to 19 inch precipitation zone)

Dell Series

The Dell series consists of sloping to moderately steep, well-drained soils. These soils formed in alluvium derived from limestone. These soils are on north-facing hillsides in the mountains. Slopes range from 6 to 20 percent. Elevations range from 7,500 to 9,000 feet. The average annual precipitation is 18 to 19 inches, the average annual soil temperature is 40° to 42° F., and the average summer soil temperature is 53° to 54° F. The frost-free season is 60 to 65 days, although frost can occur during any month. The vegetation is Douglas-fir, Engelmann spruce, and lodgepole pine.

In a representative profile, 1 inch of forest litter covers a surface layer of dark grayish-brown, slightly acid loam about 3 inches thick. The upper part of the subsurface layer is light brownish-gray, slightly acid loam about 3 inches thick, and the lower part is brown, slightly acid clay loam about 4 inches thick. The subsoil is dark-brown, brown, or yellowish-brown, slightly acid or neutral clay loam, about 22 inches thick, that is stony in the lower 12 inches. The substratum is yellowish-brown, moderately alkaline stony clay loam, about 10 inches thick, that is underlain by fractured limestone at a depth of about 42 inches.

Permeability is moderately slow, and the available water capacity is high. The effective rooting depth is 40 inches or more.

These soils are used for woodland and watershed.

Representative profile of Dell loam, in an area of Cloud Peak-Dell association, about one-quarter mile west of the old Flagle sawmill, in the SW¼NE¼ sec. 23, T. 45 N., R. 85 W.

O1—1 inch to 0, decomposed forest litter.

A1—0 to 3 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; moderate, coarse,

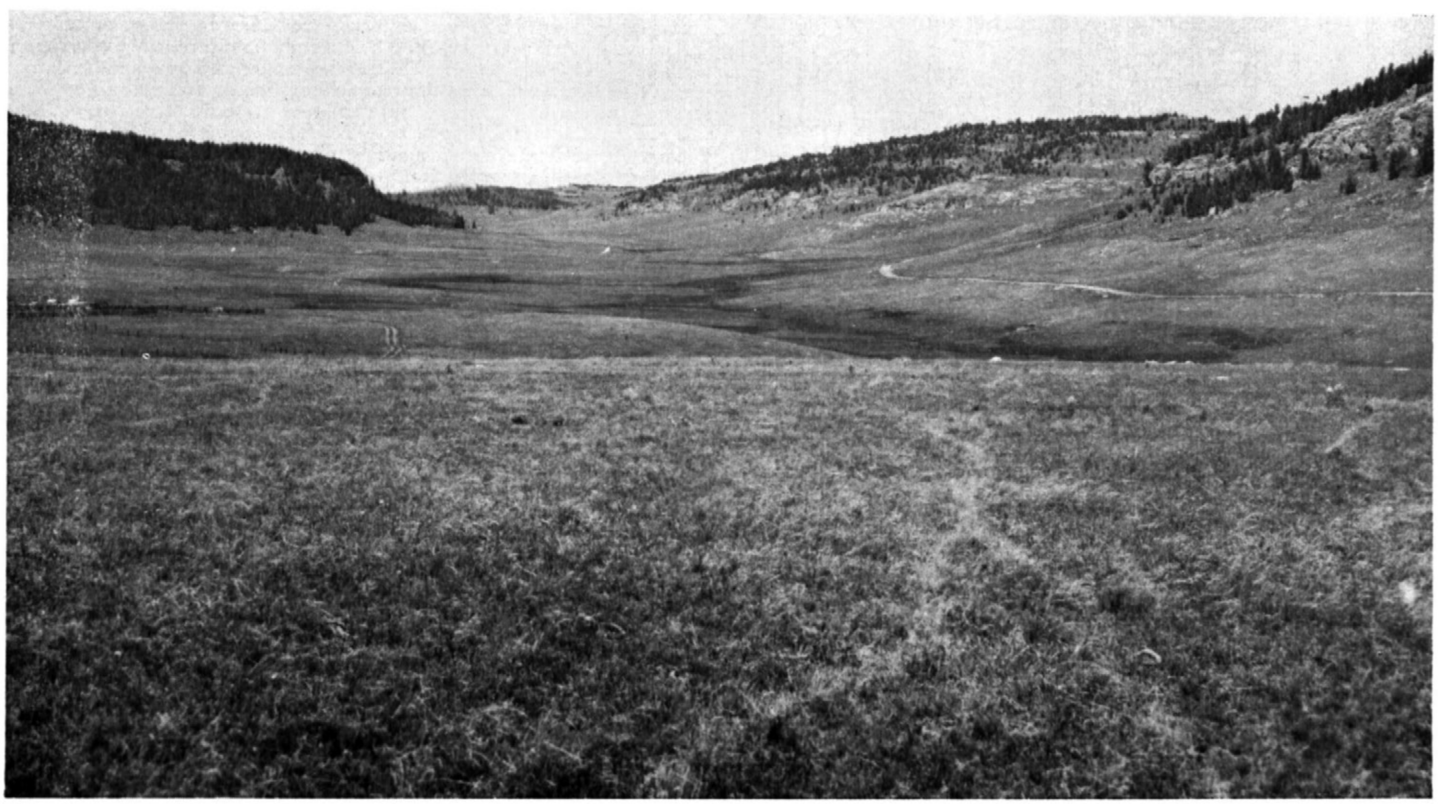

Figure 7.—**Decross-Woosley association is in foreground.**

crumb structure; soft, very friable; many roots; slightly acid; clear, smooth boundary.

A2—3 to 6 inches, light brownish-gray (10YR 6/2) loam, grayish brown (10YR 5/2) moist; weak, thin, platy structure parting to weak, fine, crumb; soft, very friable; many bleached sand grains; few roots; slightly acid; gradual, wavy boundary.

A&B—6 to 10 inches, brown (10YR 5/3) clay loam, dark yellowish brown (10YR 3/4) moist; pockets of light-gray (10YR 7/2) bleached material from the A2 horizon; weak, fine, angular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; thin patchy clay films; few roots; slightly acid; gradual, wavy boundary.

B21t—10 to 13 inches, dark-brown (10YR 4/3) clay loam, dark yellowish brown (10YR 4/4) moist; moderate, fine, angular blocky structure parting to strong, very fine, angular blocky; hard, firm, sticky and plastic; thick continuous clay films on ped faces; few large tree roots; slightly acid; clear, wavy boundary.

B22t—13 to 20 inches, brown (7.5YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; strong, fine and very fine, angular blocky structure; hard, firm, sticky and plastic; thick continuous clay films on all ped faces; few tree roots; slightly acid; clear, smooth boundary.

B3—20 to 32 inches, yellowish-brown (10YR 5/4) stony clay loam, dark yellowish brown (10YR 4/4) moist; moderate, fine, angular blocky structure; slightly hard, firm, sticky and plastic; thin patchy clay films; many stones which make up less than 50 percent of mass; neutral; gradual, wavy boundary.

C—32 to 42 inches, yellowish-brown (10YR 5/4) stony clay loam, dark brown (10YR 4/3) moist; massive; slightly hard, firm, sticky and slightly plastic; 40 percent stones; slight effervescence; moderately alkaline; gradual, wavy boundary.

R—42 inches, fractured limestone bedrock.

Depth to bedrock is 40 inches or more, depth to calcareous material ranges from 26 to 40 inches, and thickness of the solum ranges from 24 to 40 inches. These soils have a calcareous C horizon, but they do not have a consistent accumulation of secondary carbonates. Content of coarse fragments ranges from 5 to 45 percent but typically is about 10 percent throughout the solum and 25 percent in the C horizon.

The A2 horizon ranges from 10YR to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It ranges from medium acid to neutral.

The B2t horizon ranges from 10YR to 7.5YR in hue, ranges from 4 to 6 in value when dry and is 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It is clay loam or clay and is 35 to 45 percent clay. This horizon ranges from slightly acid to mildly alkaline.

The C horizon ranges from 2.5Y to 7.5YR in hue. It ranges from mildly alkaline to strongly alkaline.

Dell soils are mapped in an association with Cloud Peak soils.

Devoe Series

The Devoe series consists of moderately steep to steep, well-drained soils. These soils formed in residuum weathered from reddish-colored shale on ridges and hillsides in the mountains. Slopes range from 10 to 40 percent. Elevations range from 7,500 to 9,000 feet. The average annual precipitation is 15 to 19 inches, the average annual soil temperature is about 41° F., and the average summer soil temperature is about 54° F. The frost-free season is 65 to 70 days, although frost can occur during any month. The vegetation is Idaho fescue, bluebunch wheatgrass, and scattered pine trees.

In a representative profile the surface layer is brown, moderately alkaline gravelly loam about 9 inches thick. The subsoil is light reddish-brown, moderately alkaline gravelly clay loam, about 6 inches thick, that is underlain by reddish-brown shale at a depth of about 15 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is 10 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Devoe gravelly loam in the NW¼SW¼ sec. 26, T. 45 N., R. 84 W.

A1—0 to 9 inches, brown (7.5YR 5/3) gravelly loam, dark brown (7.5YR 3/3) moist; strong, fine, crumb structure; soft, very friable; 20 percent pebbles and cobblestones, much of which is concentrated at the surface; strong effervescence; moderately alkaline; gradual, smooth boundary.

B2—9 to 15 inches, light reddish-brown (5YR 6/4) gravelly clay loam, reddish brown (5YR 4/4) moist; weak prismatic structure parting to fine subangular blocky; slightly hard, very friable; 15 percent pebbles, mostly limestone; strong effervescence; moderately alkaline; gradual, wavy boundary.

C—15 inches, reddish-brown, calcareous shale that has thin discontinuous lenses of limestone.

Depth to bedrock ranges from 10 to 20 inches. Content of coarse fragments ranges from 15 to 25 percent. The fragments mainly are limestone pebbles and cobblestones. The profile is typically gravelly loam or gravelly clay loam, but in some places it is gravelly sandy clay loam. Less than 35 percent of the sand fraction is fine sand or coarser.

The A1 horizon ranges from 7.5YR to 2.5YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. It is mildly alkaline or moderately alkaline. In most places it has fine crumb structure, but in some places it has subangular blocky structure. This horizon is soft or slightly hard when dry.

The B2 horizon ranges from 5YR to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 3 to 5 in chroma when dry or moist. It is moderately alkaline or strongly alkaline.

Devoe-Rock land complex, 10 to 30 percent slopes (DRD).—This complex is about 60 percent Devoe gravelly loam, 10 to 30 percent slopes, and about 20 percent Rock land. The Devoe soil has the profile described as representative of the Devoe series. These soils occupy ridges. The Devoe soil is on hillsides and ridge crests, and the Rock land is ledges and outcrops, typically at the upper edge of ridges.

Included with these soils in mapping are areas of Tripit soils that make up about 15 percent of the acreage and areas of Amsden soils that make up about 5 percent.

Runoff is rapid, and the hazard of erosion is high.

Soils of this complex are used for range and wildlife habitat. (Capability unit VIIe-14, dryland. Devoe soil in Shallow Clayey range site, 15 to 19 inch precipitation zone, and Rock land not in a range site)

Embry Series

The Embry series consists of sloping or moderately steep, well-drained soils. These soils formed in alluvium derived from sandstone. They are on foot slopes. Slopes range from 6 to 20 percent. Elevations range from 4,500 to 5,000 feet. The average annual precipitation is 10 to 14 inches, the average annual soil temperature is 50° F., and the frost-free season is 105 to 110 days. The vegetation is prairie sandreed, blue grama, and silver sagebrush.

In a representative profile the surface layer is light brownish-gray, slightly acid sandy loam about 16 inches

thick. The underlying layer is light brownish-gray or pale-brown, neutral sandy loam that reaches to a depth of 60 inches or more.

Permeability is moderately rapid, and the available water capacity is moderate to high. The effective rooting depth is 60 inches or more.

These soils are used for range and wildlife habitat.

Representative profile of Embry sandy loam, in an area of Gateson-Embry association, in the SW¼SW¼ sec. 12, T. 42 N., R. 78 W.

A1—0 to 16 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; moderate, fine, granular structure; soft, very friable; slightly acid; clear, smooth boundary.

C1—16 to 23 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; massive to weak subangular blocky structure; slightly hard, very friable; few small krotovinas; neutral; gradual, wavy boundary.

C2—23 to 60 inches, pale-brown (10YR 6/3) sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, very friable; neutral.

Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent. The fragments are mainly shale. The texture between depths of 10 and 40 inches generally is sandy loam, but it is fine sandy loam or loam in places. More than 35 percent of the sand fraction is fine sand or coarser.

The A1 horizon ranges from 2.5Y to 7.5YR, is 5 or 6 in value when dry and 4 or 5 when moist, and is 2 or 3 in chroma when dry or moist. It ranges from medium acid to mildly alkaline. In most places it has granular structure, but in some places it has subangular blocky structure. This horizon is soft or slightly hard when dry.

The C horizon ranges from 2.5Y to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It is slightly acid or neutral.

Embry soils are mapped in associations with Cushman, Gateson, Maysdorf, Pugsley, and Schooner soils.

Englewood Series

The Englewood series consists of sloping, well-drained soils. These soils formed in alluvium derived from shale. They are on foot slopes. Slopes range from 6 to 10 percent. Elevations range from 5,000 to 5,500 feet. The average annual precipitation is 12 to 14 inches, the average annual soil temperature is about 50° F., and the frost-free season is 100 to 105 days. The vegetation is western wheatgrass, green needlegrass, and big sagebrush.

In a representative profile the surface layer is grayish-brown, neutral silty clay loam about 3 inches thick. The subsoil is dark grayish-brown or grayish-brown, neutral or mildly alkaline silty clay or clay about 31 inches thick. The substratum is grayish-brown, moderately alkaline clay that reaches to a depth of 60 inches.

Permeability is slow, and the available water capacity is high. The effective rooting depth is 50 to 60 inches.

These soils are used for range and wildlife habitat.

Representative profile of Englewood silty clay loam, in an area of Wormser-Englewood association, in the NW¼NW¼ sec. 26, T. 42 N., R. 83 W.

A1—0 to 3 inches, grayish-brown (2.5Y 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; moderate, medium, crumb structure; soft, firm, sticky and plastic; many roots; neutral; clear, smooth boundary.

B1—3 to 7 inches, dark grayish-brown (2.5Y 4/2) silty clay, very dark grayish brown (2.5Y 3/2) moist; moderate, very fine, subangular blocky structure parting to strong, medium, crumb; hard, firm, sticky and plastic; very many roots; neutral; clear, smooth boundary.

B21t—7 to 16 inches, dark grayish-brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; moderate, medium, prismatic structure parting to moderate, fine, subangular blocky; extremely hard, extremely firm, very sticky and very plastic; thick continuous clay films on all surfaces; many roots; neutral; clear, smooth boundary.

B22t—16 to 22 inches, grayish-brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) moist; weak, fine to medium, subangular blocky structure; hard, extremely firm, very sticky and very plastic; few roots; few, thick, patchy clay films on ped faces; many polished surfaces; neutral; clear, smooth boundary.

B3—22 to 34 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; weak, medium, subangular blocky structure; very hard, extremely firm, very sticky and very plastic; few, thin, patchy clay films on ped faces; many polished surfaces; very few roots; mildly alkaline; clear, smooth boundary.

Cca—34 to 60 inches, grayish-brown (2.5Y 5/2) clay, dark grayish brown (2.5 4/2) moist; massive; hard, very firm, very sticky and very plastic; strong effervescence; few fine patches and many coarse patches of carbonates; moderately alkaline.

In most places depth to bedrock is 60 inches or more, but in some places, it is 50 to 60 inches. Depth to calcareous material ranges from 18 to 36 inches, and thickness of the solum ranges from 18 to 40 inches. Content of coarse fragments ranges from 0 to 10 percent but typically is less than 5 percent.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and ranges from 1 to 3 in chroma when dry or moist. The A and B horizons are neutral or mildly alkaline.

The B2t horizon ranges from 2.5Y to 10YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and ranges from 1 to 3 in chroma when dry or moist.

The C horizon ranges from 2.5Y to 10YR in hue. It is heavy clay loam or clay that is about 38 to 45 percent clay.

Englewood soils are mapped in an association with Wormser soils.

Fort Collins Series

The Fort Collins series consists of nearly level to moderately steep, well-drained soils. These soils formed in alluvium. They are on alluvial fans and foot slopes. Slopes range from 0 to 15 percent. Elevations range from 4,500 to 5,200 feet. The average annual precipitation is 10 to 14 inches, the average annual soil temperature is about 51° F., and the frost-free season is 100 to 105 days. The vegetation is western wheatgrass, blue grama, and big sagebrush.

In a representative profile the surface layer is light brownish-gray, neutral fine sandy loam about 5 inches thick. The upper part of the subsoil is grayish-brown, mildly alkaline loam about 3 inches thick, and the lower part is brown or yellowish-brown, mildly alkaline clay loam about 13 inches thick over pale-brown, strongly alkaline loam about 9 inches thick. The substratum is pale-brown, strongly alkaline loam that reaches to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more.

These soils are used for irrigated hay, pasture, and small grain; for dryland small grain; for range; and as wildlife habitat.

Representative profile of Fort Collins fine sandy loam, in an area of Fort Collins-Ulm association, in the center of sec. 29, T. 45 N., R. 81 W.

A1—0 to 5 inches, light brownish-gray (10YR 6/2) fine sandy loam, grayish brown (10YR 5/2) moist; moderate, fine, granular structure; soft, very friable, nonsticky and nonplastic; many roots; neutral; clear, smooth boundary.

B1—5 to 8 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; moderate, fine, angular blocky structure; slightly hard, friable, sticky and slightly plastic; few roots; thin clay films on vertical and horizontal ped faces; mildly alkaline; clear, smooth boundary.

B21t—8 to 15 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; weak, medium, prismatic structure parting to weak, medium, angular blocky; slightly hard, firm, sticky and plastic; few roots; thick continuous clay films on vertical and horizontal ped faces; mildly alkaline; clear, smooth boundary.

B22t—15 to 21 inches, yellowish-brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; weak, coarse, prismatic structure parting to weak, medium, angular blocky; slightly hard, friable, slightly sticky and slightly plastic; very few roots; thin patches of clay films on horizontal and vertical ped faces; mildly alkaline; clear, smooth boundary.

B3ca—21 to 30 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) moist; weak, coarse, angular blocky structure; loose, very friable, nonsticky and nonplastic; strong effervescence; few thin clay films on vertical and horizontal ped faces; few fine threads of carbonates; strongly alkaline; clear, smooth boundary.

Cca—30 to 60 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) moist; massive; loose, very friable, nonsticky and nonplastic; thin seams of secondary calcium carbonate; strongly alkaline.

Depth to calcareous material ranges from 14 to 24 inches, and thickness of the solum ranges from 16 to 30 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 2 or 3 in chroma when dry or moist. The A horizon and upper part of the B horizon are neutral or mildly alkaline.

The B2t horizon ranges from 2.5Y to 10YR in hue, ranges from 4 to 6 in value when dry and is 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It is heavy loam or clay loam that is 20 to 35 percent clay.

The C horizon ranges from 2.5Y to 10YR in hue. It is moderately alkaline or strongly alkaline.

Fort Collins loam, 0 to 3 percent slopes (FcA).—This soil is on alluvial fans. It has a profile similar to the one described as representative of the series, except that the surface layer is loam 6 to 8 inches thick.

Included with this soil in mapping are areas of Stoneham and Zigweid soils.

Runoff is slow, and the hazard of water erosion is slight. The hazard of wind erosion is moderate.

This soil is used for irrigated hay, pasture, and small grain and for dryland spring wheat and hay. (Capability units IVe–2, dryland, and IIe–2, irrigated; Loamy range site, 10 to 14 inch precipitation zone)

Fort Collins loam, 3 to 6 percent slopes (FcB).—This soil is on alluvial fans. It has a profile similar to the one described as representative of the series, except that the surface layer is loam about 6 to 8 inches thick.

Included with this soil in mapping are areas of Stoneham, Zigweid, and Kim soils.

Runoff is medium, and the hazard of water erosion is moderate.

This soil is used for irrigated hay, pasture, and small grain and for dryland spring wheat and hay. (Capability units IVe–2, dryland, and IIIe–2, irrigated; Loamy range site, 10 to 14 inch precipitation zone)

Fort Collins-Ascalon association (FO).—This association is about 45 percent Fort Collins fine sandy loam, 6 to 15 percent slopes, and about 25 percent Ascalon fine sandy loam, 6 to 15 percent slopes. These soils occupy alluvial fans at the base of high terraces. The Fort Collins soil is in lower valleys, and the Ascalon soil is in upper valleys and pockets that are snowpack areas.

Included with these soils in mapping are areas of Wolf soils that make up about 15 percent of the acreage, areas of Ulm soils that make up about 10 percent, and areas of Stoneham soils that make up about 5 percent.

Runoff is medium to rapid, and the hazard of water erosion is moderate to high. If the cover is destroyed, the hazard of wind erosion is high.

Soils of this association are used for range and wildlife habitat. (Fort Collins soil in capability unit VIe–2, dryland, Ascalon soil in capability unit VIe–5, dryland. Both soils in Loamy range site, 10 to 14 inch precipitation zone)

Fort Collins-Ulm association (FU).—This association is about 50 percent Fort Collins fine sandy loam, 3 to 10 percent slopes, and 30 percent Ulm loam, 3 to 10 percent slopes. These soils have the profiles described as representative of the Fort Collins and Ulm series. They occupy alluvial fans. The Fort Collins soil is in the upper areas and on convex fans, and the Ulm soil is in the lower valleys and on concave parts of the landscape.

Included with these soils in mapping are areas of Stoneham soils that make up about 10 percent of the acreage. Also included are areas of Cragola soils that make up about 5 percent and areas of Shingle soils that make up about 5 percent. The Cragola and Shingle soils are on low ridges.

Runoff is slow to medium, and the hazard of water erosion is slight to moderate. If the cover is destroyed, the hazard of wind erosion is high on the Fort Collins soil.

Soils of this association are used for range and wildlife habitat. (Capability unit IVe–2, dryland; Loamy range site, 10 to 14 inch precipitation zone)

Garrett Series

The Garrett series consists of sloping or moderately steep, well-drained soils. These soils formed in alluvium derived from reddish-colored sandstone and siltstone. They are on foot slopes. Slopes range from 6 to 15 percent. Elevations range from 4,500 to 5,200 feet. The average annual precipitation is 10 to 14 inches, the average annual soil temperature is about 52° F., and the frost-free season is 105 to 110 days. The vegetation is western wheatgrass, blue grama, big sagebrush, and needle-and-thread.

In a representative profile the surface layer is grayish-brown, neutral sandy loam about 4 inches thick. The upper part of the subsoil is brown, neutral sandy loam about 5 inches thick, and the lower part is reddish-brown, neu-

tral or mildly alkaline sandy clay loam or sandy loam about 27 inches thick. The substratum is light reddish-brown, moderately alkaline sandy loam that reaches to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is moderate to high. The effective rooting depth is 60 inches or more.

These soils are used for range and wildlife habitat.

Representative profile of Garrett sandy loam, in an area of Maysdorf-Garrett association, in the unsectionized part of Johnson County 3 miles east of Urrity Ranch headquarters.

A1—0 to 4 inches, grayish-brown (10YR 5/2) sandy loam, dark brown (10YR 3/3) moist; strong, very fine, granular structure; soft, very friable; neutral; clear, smooth boundary.

B1—4 to 9 inches, brown (7.5YR 5/3) sandy loam, dark brown (7.5YR 3/3) moist; weak, very coarse, prismatic structure parting to weak, coarse, subangular blocky; slightly hard, very friable; thin glossy coatings on some sand grains; neutral; clear, smooth boundary.

B21t—9 to 24 inches, reddish-brown (5YR 5/3) sandy clay loam, dark reddish brown (5YR 3/3) moist; moderate, coarse, prismatic structure parting to moderate, coarse, subangular blocky; slightly hard, very friable; thin waxlike patches on ped faces; glossy coatings in root channels; thin waxlike coatings on sand grains and waxlike bridgings between sand grains; neutral; clear, wavy boundary.

B22t—24 to 30 inches, reddish-brown (5YR 5/3) sandy clay loam, reddish brown (5YR 4/3) moist; moderate, coarse, prismatic structure parting to moderate, coarse, subangular blocky; slightly hard, very friable; peds are hard; thin waxlike bridgings between sand grains; neutral; gradual, smooth boundary.

B3—30 to 36 inches, reddish-brown (5YR 5/3) sandy loam, reddish brown (5YR 4/3) moist; weak, coarse, subangular blocky structure; slightly hard, very friable; a few glossy coatings on sand grains and a few waxlike bridgings between sand grains; mildly alkaline; gradual, smooth boundary.

Cca—36 to 60 inches, light reddish-brown (5YR 6/3) sandy loam, reddish brown (5YR 4/3) moist; massive; soft, very friable; some visible secondary calcium carbonate occurring as concretions, in thin seams and streaks, and as coatings on sand grains; strong effervescence; moderately alkaline.

The A1 horizon ranges from 10YR to 7.5YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. In most places the primary structure is granular, but in some places it is subangular blocky. This horizon is soft or slightly hard when dry. The A and B horizons are neutral or mildly alkaline.

The B21t horizon ranges from 5YR to 10R in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. The B22t horizon ranges from 5YR to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 3 or 4 in chroma when dry or moist. In most places the primary structure in the B horizon is coarse and prismatic, but in some places it is subangular blocky. This horizon generally is sandy clay loam, but in some places it is loam or sandy loam. More than 35 percent of the sand fraction is fine sand or coarser.

The C horizon ranges from 5YR to 10R in hue. It is mildly alkaline or moderately alkaline.

Garrett soils are mapped in associations with Maysdorf and Pugsley soils.

Gateson Series

The Gateson series consists of moderately steep or steep, well-drained to somewhat excessively drained soils. These soils formed in residuum weathered from sandstone. They are on ridges and hillsides on Pine Ridge, near Sussex and Linch. Slopes range from 10 to 30 percent. Elevations range from 5,000 to 6,000 feet. The average annual precipitation is 12 to 14 inches, the average annual soil temperature is about 46° F., and the frost-free season is 90 to 100 days. The vegetation is ponderosa pine and a sparse undercover of grass and woody plants.

In a representative profile 4 inches of forest litter covers a surface layer of grayish-brown, slightly acid loam about 2 inches thick. The upper part of the subsurface layer is white, slightly acid very fine sandy loam about 8 inches thick, and the lower part is mixed, mainly white and grayish-brown, slightly acid loam 4 inches thick. The subsoil is grayish-brown, medium acid clay loam, about 10 inches thick, that is underlain by sandstone and shale at a depth of about 24 inches.

Permeability is moderate, and the available water capacity is low to moderate. The effective rooting depth is 20 to 40 inches.

These soils are used as woodland and wildlife habitat.

Representative profile of Gateson loam, in an area of Gateson-Embry association, in the SE¼SW¼ sec. 12, T. 42 N., R. 78 W.

O1—4 inches to 1 inch, undecomposed organic material that mainly consists of needles, bark, twigs, and pine cones.

O2—1 inch to 0, partly decomposed organic material that mainly consists of needles, bark, twigs, and pine cones.

A1—0 to 2 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; moderate, fine, crumb structure; soft, very friable; slightly acid; clear, wavy boundary.

A2—2 to 10 inches, white (10YR 8/2) very fine sandy loam, light brownish gray (2.5Y 6/2) moist; moderate, thin, platy structure parting to moderate, fine, granular; soft, very friable; vesicular; slightly acid; gradual, wavy boundary.

A&B—10 to 14 inches, mixed colors that include grayish-brown (10YR 5/2) and white (10YR 8/2) loam, dark grayish brown (10YR 4/2) and light brownish gray (2.5Y 6/2) moist; moderate, fine, subangular blocky structure; slightly hard, very friable; thin glossy patches on the more clayey ped faces; this horizon consists of seams and nodules of clayey material from the B2t horizon embedded in a light-colored matrix of material from the A2 horizon; slightly acid; diffuse, wavy boundary.

B2t—14 to 24 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate, slightly hard, very friable; individual peds are very hard; thin, inconsistent, light-colored coatings of bleached sand and silt on some ped faces; many, thin, waxlike patches on ped faces and waxlike coatings in root channels; medium acid; gradual, wavy boundary.

C—24 inches, noncalcareous shale and thin discontinuous lenses of sandstone.

Depth to bedrock ranges from 20 to 40 inches. The A1 horizon is lacking in some profiles.

The A2 horizon ranges from 2.5Y to 10YR in hue, from 6 to 8 in value when dry and from 4 to 6 when moist, and from 2 to 4 in chroma when dry or moist. It ranges from medium acid to mildly alkaline. In most places the primary structure is platy, but in some places it is granular or subangular blocky. This horizon is soft or slightly hard when dry.

The B2t horizon ranges from 2.5Y to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It ranges from strongly acid to neutral. It generally is clay loam, but in places it is silt loam, loam, or sandy clay loam. Less than 35 percent of the sand fraction is fine sand or coarser.

Gateson-Embry association (GA).—This association is about 40 percent Gateson loam, 10 to 30 percent slopes, and about 30 percent Embry sandy loam, 6 to 20 percent slopes. These soils have the profiles described as representative of the Gateson and Embry series. They occupy hillsides and foot slopes. The Gateson soil is on north- and east-facing hillsides under pine trees, and the Embry soil is on foot slopes under grass.

Included with these soils in mapping are areas of Schooner soils that make up about 20 percent of the acreage. Also included are areas of Pugsley soils that make up about 5 percent and areas of Rencalson soils that make up about 5 percent.

Runoff is rapid on the Gateson soil and medium to rapid on the Embry soil. The hazard of water erosion is high on the Gateson soil and moderate to high on the Embry soil. If the cover is destroyed, the hazard of wind erosion is high on the Embry soil.

Soils of this association are used for woodland and range. The dominant tree species in woodland on the Gateson soil is ponderosa pine. Woodland production is limited to posts, poles, and isolated tracts of sawtimber. The trees increase in size and density as rainfall and elevation increase, toward the southern county line. The Gateson part of this association is in woodland group 5. (Gateson soil in capability unit VIe–2, dryland; not in a range site. Embry soil in capability unit VIe–5, dryland, and Sandy range site, 10 to 14 inch precipitation zone)

Gaynor Series

The Gaynor series consists of sloping or moderately steep, well-drained soils. These soils formed in residuum weathered from shale. They are on uplands and are extensive in the area of Ninemile Creek and Fourmile Creek. Slopes range from 6 to 20 percent. Elevations range from 4,500 to 5,200 feet. The average annual precipitation is 10 to 14 inches, the average annual soil temperature is about 51° F., and the frost-free season is 105 to 110 days. The vegetation is western wheatgrass, big sagebrush, and green needlegrass.

In a representative profile these soils are light olive-brown, moderately alkaline or strongly alkaline clay or silty clay underlain by shale at a depth of about 24 inches.

Permeability is slow, and the available water capacity is low to moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of a Gaynor soil, in an area of Razor-Gaynor-Samsil complex, hilly, in the NW¼NE¼ sec. 3, T. 43 N., R. 78 W.

A1—0 to 1 inch, light olive-brown (2.5Y 5/4) silty clay, olive brown (2.5Y 4/4) moist; weak, medium, crumb structure; loose, firm, very sticky and plastic; moderate effervescence; moderately alkaline; clear, smooth boundary.

C1—1 inch to 12 inches, light olive-brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) moist; weak, coarse, angular blocky structure; hard, very firm, very sticky and plastic; few, fine, faint threads of calcium carbonate in the lower part; moderate effervescence; strongly alkaline; clear, smooth boundary.

C2ca—12 to 24 inches, light olive-brown (2.5Y 5/4) clay, olive brown (2.5Y 4/4) moist; massive; very hard, extremely firm, very sticky and plastic; many, medium, distinct threads and nodules of secondary lime accumulations; moderate effervescence; strongly alkaline; clear, smooth boundary.

C3—24 inches, olive, calcareous, platy shale.

These soils generally are calcareous to the surface, but in places they are leached in the uppermost 2 to 4 inches. Depth to bedrock ranges from 20 to 40 inches. Content of coarse fragments ranges from 0 to 10 percent but typically is less than 5 percent. These soils are moderately alkaline or strongly alkaline.

The A horizon ranges from 5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 3 to 5 in chroma when dry or moist.

The C horizon ranges from 5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 3 to 5 in chroma when dry or moist. It is heavy clay loam, silty clay, or clay, and the clay content ranges from 38 to 50 percent.

Gaynor soils are mapped in associations or complexes with Danko, Limon, Razor, Renohill, and Samsil soils.

Glenberg Series

The Glenberg series consists of nearly level, well-drained soils. These soils formed in sandy alluvium on flood plains. Slopes range from 0 to 3 percent. Elevations range from 4,500 to 5,000 feet. The average annual precipitation is 10 to 12 inches, the average annual soil temperature is about 51° F., and the frost-free season is 110 to 120 days. The vegetation is silver sagebrush, blue grama, and cottonwood trees.

In a representative profile the surface layer is light olive-gray, moderately alkaline sandy loam about 3 inches thick. The underlying layer is light yellowish-brown, pale-olive, and light olive-brown, moderately alkaline or strongly alkaline sandy loam that is stratified in the lower part with lenses of loam and loamy sand. This material reaches to a depth of 60 inches or more.

Permeability is moderately rapid, and the available water capacity is moderate. The effective rooting depth is more than 60 inches.

These soils are used for range: for irrigated hay, pasture, and small grain; and as wildlife habitat.

Representative profile of Glenberg sandy loam, in an area of Glenberg-Bankard association, one-fourth mile south of Garrett Ranch Hunting Camp on the Dry Fork of Powder River in the unsectionized part of Johnson County.

A1—0 to 3 inches, light olive-gray (5Y 6/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; moderate, medium and fine, crumb structure; soft, very friable, slightly sticky and nonplastic; moderate effervescence; many roots; moderately alkaline; clear, smooth boundary.

AC—3 to 14 inches, light yellowish-brown (2.5Y 6/4) sandy loam, olive brown (2.5Y 4/4) moist; moderate, thick, platy structure parting to weak, fine, crumb; soft, very friable, slightly sticky and nonplastic; moderate effervescence; many roots; moderately alkaline; gradual, wavy boundary.

C1—14 to 31 inches, pale-olive (5Y 6/4) sandy loam, olive brown (2.5Y 4/4) moist; massive parting to weak, fine, crumb structure; loose, friable, slightly sticky and slightly plastic; moderate effervescence; very few roots; moderately alkaline; clear, smooth boundary.

C2ca—31 to 60 inches, light olive-brown (2.5Y 5/4) sandy loam stratified with lenses of loam and loamy sand, olive brown (2.5Y 4/4) moist; massive; soft, friable, slightly sticky and slightly plastic; violent effervescence; many, medium, distinct threads and seams

of calcium carbonate; very few roots; strongly alkaline.

These soils generally are calcareous to the surface, but in places they are leached in the uppermost 2 to 4 inches. Content of coarse fragments ranges from 0 to 10 percent but typically is less than 5 percent.

The A and C horizons range from 5Y to 10YR in hue, are 5 or 6 in value when dry and 4 or 5 when moist, and range from 2 to 5 in chroma when dry or moist. They are moderately alkaline or strongly alkaline. Between depths of 10 and 40 inches, the soil material is mainly sandy loam, but the content of clay is 10 to 18 percent.

Glenberg fine sandy loam (Gd).—This soil is on flood plains adjacent to the stream channel and is occasionally flooded. It has a profile similar to the one described as representative of the series, except that the surface layer is fine sandy loam 6 to 8 inches thick. Slopes are 0 to 3 percent.

Included with this soil in mapping are areas of Bankard and Haverson soils.

Runoff is slow, and the hazard of water erosion is slight. If the soil is left bare, the hazard of wind erosion is high.

This soil is used for irrigated hay, pasture, and small grain. (Capability units IVe–5, dryland, and IIe–5, irrigated; Lowland range site, 10 to 14 inch precipitation zone)

Glenberg fine sandy loam, sand substratum (Ge).—This soil is occasionally flooded. It has a profile similar to the one described as representative of the series, except that the surface layer is fine sandy loam 6 to 8 inches thick and below a depth of 30 inches are thick strata of sand and loamy sand. Because there is sandy material in the lower part of this soil, the water-holding capacity is less. Slopes are 0 to 3 percent.

Included with this soil in mapping are areas of Bankard and Haverson soils and Glenberg fine sandy loam.

Runoff is slow, and the hazard of water erosion is slight.

This soil is used for irrigated hay, pasture, and small grain. (Capability units IVe–5, dryland, and IIIs–5, irrigated; Lowland range site, 10 to 14 inch precipitation zone)

Glenberg-Bankard association (GG).—This association is about 40 percent Glenberg sandy loam, 0 to 3 percent slopes, and about 30 percent Bankard loamy sand, 0 to 3 percent slopes. These soils have the profiles described as representative of the Glenberg and Bankard series. They are intermingled in a complex pattern. In some landscapes the Glenberg soil is on the part that is farthest away from the stream channel, and the Bankard soil is on the part that is adjacent to the stream channel. These soils are occasionally flooded. Along some stream bottoms, such as Murphy Creek, the soils in this association have an accumulation of soluble salts.

Included with these soils in mapping are areas of Haverson soils, areas of noncalcareous soils that are similar to this Bankard soil, and the area occupied by the stream channel.

Runoff is slow, and the hazard of water erosion is slight. If the cover is destroyed, the hazard of wind erosion is high.

Soils of this association are used for range and wildlife habitat. (Glenberg soil in capability unit IVe–5, dryland, and Lowland range site, 10 to 14 inch precipitation zone. Bankard soil in capability unit VIe–15, dryland, and Sands range site, 10 to 14 inch precipitation zone)

Gullied Land

Gullied land (GU) consists of highly dissected valleys and and uplands entrenched by numerous, steep-sided, actively eroding gullies. The areas consist of deeply entrenched drainageways or a network of gullies. Because the gullies dominate the landscape, the areas of this land type are practically unusable. Small, isolated bodies of highly eroded soils are between the gullies in many places.

Gullied land is used as wildlife habitat. (Capability unit VIIIe–82; range site not assigned)

Gystrum Series

The Gystrum series consists of moderately steep or steep, well-drained soils. These soils formed in residuum weathered from gypsum bedrock on uplands. Slopes range from 10 to 30 percent. Elevations range from 5,000 to 6,000 feet. The average annual precipitation is 12 to 13 inches, the average annual soil temperature is about 51° F., and the frost-free season is 100 to 105 days. The vegetation is threadleaf sedge and western wheatgrass.

In a representative profile the surface layer is reddish-brown, moderately alkaline silt loam about 5 inches thick. The subsoil is reddish-brown, strongly alkaline silt loam about 5 inches thick. The substratum is light reddish-brown or light-gray, strongly alkaline or moderately alkaline silt loam, about 17 inches thick, that is underlain by soft gypsum bedrock at a depth of about 27 inches.

Permeability and the available water capacity are moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Gystrum silt loam, in an area of Pokeman-Gystrum-Rekop association, in the SW¼NW¼ sec. 11, T. 42 N., R. 84 W.

A11—0 to 2 inches, reddish-brown (5YR 5/4) silt loam, dark reddish brown (5YR 3/3) moist; weak, fine, crumb structure; slightly hard, very friable, slightly sticky and plastic; slight effervescence; moderately alkaline; clear, smooth boundary.

A12—2 to 5 inches, reddish-brown (5YR 5/3) silt loam, reddish brown (5YR 4/3) moist; medium, fine and coarse, crumb structure; soft, very friable, slightly sticky and slightly plastic; strong effervescence; moderately alkaline; clear, smooth boundary.

B2—5 to 10 inches, reddish-brown (5YR 5/4) silt loam, reddish brown (5YR 4/4) moist; weak, coarse and medium, angular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many, fine, faint specks of calcium carbonate and few chert fragments, ½ to 1 inch in diameter; violent effervescence; strongly alkaline; clear, smooth boundary.

C1cacs—10 to 17 inches, light reddish-brown (5YR 6/4) silt loam, brown (7.5YR 5/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many, fine and medium, distinct threads and nodules of calcium carbonate and calcium sulfate; violent effervescence; strongly alkaline; gradual, wavy boundary.

C2cacs—17 to 27 inches, light-gray (7.5YR 7/1) silt loam, pinkish gray (7.5YR 6/2) moist; massive; soft, friable, slightly sticky and slightly plastic; violent effervescence; moderately alkaline; gradual, wavy boundary.

C3—27 inches, soft, gypsum bedrock.

Depth to bedrock ranges from 20 to 40 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent.

The A1 horizon ranges from 7.5YR to 2.5YR in hue, is 5 or 6 in value when dry and ranges from 3 to 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. Where the A1 horizon has a color value as dark as 3 when moist, it is only 2 to 3 inches thick. It is mildly alkaline or moderately alkaline.

The B2 horizon ranges from 7.5YR to 2.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 3 or 4 in chroma when dry or moist. In most places it has angular blocky structure, but in some places it has weak, prismatic structure. This horizon typically has evidence of translocation of carbonates. The B and C horizons are moderately alkaline or strongly alkaline.

The C horizon ranges from 7.5YR to 2.5YR in hue. It is silt loam or silty clay loam that is 18 to 35 percent clay. It contains small crystals and thin seams of finely divided gypsum and other salts.

Gystrum soils are mapped in a complex with Pokeman and Rekop soils.

Harlan Series

The Harlan series consists of gently sloping to moderately steep, well-drained soils. These soils formed in alluvium derived from red-bed sandstone and siltstone. They are on alluvial fans and foot slopes. Slopes range from 3 to 15 percent. Elevations range from 5,000 to 6,000 feet. The average annual precipitation is 12 to 13 inches, the average annual soil temperature is about 50° F., and the frost-free season is 95 to 100 days. The vegetation is western wheatgrass, blue grama, and big sagebrush.

In a representative profile the surface layer is brown, neutral loam about 5 inches thick. The upper part of the subsoil is reddish-brown, neutral or mildly alkaline loam or clay loam about 15 inches thick, and the lower part is light reddish-brown, moderately alkaline loam about 6 inches thick. The substratum is light reddish-brown, moderately alkaline loam that reaches to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is 40 to 60 inches.

These soils are used for range, as wildlife habitat, and to a minor extent for irrigated hay, pasture, and small grain.

Representative profile of Harlan loam, in an area of Harlan-Kirtley association, in the NW¼SW¼ sec. 35, T. 44 N., R. 83 W.

A1—0 to 5 inches, brown (7.5YR 5/3) loam, dark brown (7.5YR 3/3) moist; strong, very fine, granular structure; soft, very friable; neutral; clear, smooth boundary.

B1—5 to 8 inches, reddish-brown (5YR 5/3) loam, dark reddish brown (5YR 3/3) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, very friable; thin glossy patches on some ped faces; neutral; clear, smooth boundary.

B2t—8 to 20 inches, reddish-brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; strong, medium, prismatic structure parting to strong, medium, angular and subangular blocky; hard, very friable; thin, nearly continuous, waxlike coatings on ped faces; thin waxlike coatings and fillings in root channels and pores; mildly alkaline; clear, wavy boundary.

B3ca—20 to 26 inches, light reddish-brown (5YR 6/4) loam, reddish brown (5YR 5/4) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, very friable; thin glossy patches on some ped faces; a few glossy coatings in some root channels; some visible secondary calcium carbonate occurring as concretions and in thin seams and streaks; strong effervescence; moderately alkaline; gradual, wavy boundary.

Cca—26 to 60 inches, light reddish-brown (5YR 6/4) loam, reddish brown (5YR 5/4) moist; massive; hard, very friable; visible secondary calcium carbonate occurring as concretions and in thin seams and streaks; strong effervescence; moderately alkaline.

Depth to bedrock is 40 to 60 inches or more, and depth to calcareous material ranges from 8 to 20 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent.

The A1 horizon ranges from 7.5YR to 5YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. In most places the primary structure is granular or crumb, but in some places it is subangular blocky. This horizon is soft or slightly hard when dry. The A and B horizons range from neutral to moderately alkaline.

The B2t horizon ranges from 5YR to 2.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 3 to 5 in chroma when dry or moist. In most places the primary structure is prismatic, but in some places it is subangular blocky. It generally has texture of clay loam or loam that ranges from 18 to 35 percent in clay content.

The Cca horizon ranges from 5YR to 2.5YR in hue. It is moderately alkaline or strongly alkaline.

Harlan silt loam (Ha).—This soil is on alluvial fans and foot slopes, mainly below the red beds. It has a profile similar to the one described as representative of the series, except that the surface layer is silt loam about 6 to 8 inches thick. Slopes generally are 3 to 6 percent but approach 10 percent in some places.

Included with this soil in mapping are areas of Connerton, Kirtley, and La Fonda soils.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used mainly for irrigated hay, pasture, and small grain. Small areas are used for range. (Capability units IVe-2, dryland, and IIIe-2, irrigated; Loamy range site, 10 to 14 inch precipitation zone)

Harlan-Kirtley association (HD).—This association is about 50 percent Harlan loam, 3 to 15 percent slopes, and about 30 percent Kirtley loam, 6 to 15 percent slopes. These soils have the profiles described as representative of the Harlan and Kirtley series. They occupy uplands, foot slopes, and alluvial fans. The Harlan soil is on the lower foot slopes and alluvial fans leading into valleys, and the Kirtley soil is on uplands, above the Harlan soil.

Included with these soils in mapping are areas of Worf soils that make up about 15 percent of the acreage and areas of Briggsdale soils that make up about 5 percent.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

Soils of this association are used for range and wildlife habitat. (Capability unit VIe-2, dryland; Loamy range site, 10 to 14 inch precipitation zone)

Haverson Series

The Haverson series consists of nearly level, well drained soils. These soils formed in alluvium on flood

plains. Slopes range from 0 to 3 percent. Elevations range from 4,500 to 5,000 feet. The average annual precipitation is 10 to 14 inches, the average annual soil temperature is about 51° F., and the frost-free season is 105 to 120 days. The vegetation is western wheatgrass, silver sagebrush, cactus, and blue grama.

In a representative profile the surface layer is light brownish-gray, moderately alkaline loam about 4 inches thick. The underlying layer is light brownish-gray, moderately alkaline loam that is stratified with thin lenses of clay loam and sandy loam. This material reaches to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. These soils are flooded occasionally. The effective rooting depth is 60 inches or more.

These soils are used for range; for irrigated hay, pasture, and small grain; and as wildlife habitat.

Representative profile of Haverson loam, in an area of Haverson-Glenberg association, in the SW¼SW¼ sec. 4, T. 44 N., R. 78 W.

A1—0 to 4 inches, light brownish-gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; moderate, medium, granular structure; soft, very friable, slightly sticky and slightly plastic; many roots; strong effervescence; moderately alkaline; clear, smooth boundary.

C—4 to 60 inches, light brownish-gray (2.5Y 6/2) loam stratified with thin lenses of clay loam and sandy loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; strong effervescence; moderately alkaline.

These soils generally are calcareous throughout, but in places they are noncalcareous in the uppermost few inches. They range from mildly alkaline to strongly alkaline. Their profile has texture of very fine sandy loam, silt loam, loam, silty clay loam, and clay loam. Hue ranges from 10YR to 2.5YR; value is 5 or 6 when dry and 4 or 5 when moist; and chroma ranges from 2 to 4 when dry or moist. Where the A horizon has a color value as dark as 3 when moist and a value lighter than 5 when dry, it is less than 4 inches thick. Content of coarse fragments ranges from 0 to 10 percent but typically is less than 5 percent.

Haverson silt loam (He).—This soil is on flood plains along the main streams. It has a profile similar to the one described as representative of the series, except that the surface layer is silt loam 5 to 8 inches thick. Slopes are 0 to 3 percent.

Included with this soil in mapping are areas of Glenberg and Lohmiller soils.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for irrigated hay, pasture, and small grain. (Capability units IVe–2, dryland, and IIe–2, irrigated; Lowland range site, 10 to 14 inch precipitation zone)

Haverson silt loam, wet (Hf).—This soil is on flood plains adjacent to stream channels along the major drainageways. It has a profile similar to the one described as representative of the series, except that it has a surface layer of silt loam 5 to 8 inches thick and accumulations of soluble salts. Also, it has a high water table. The accumulations of soluble salts are slight to moderate. The soil is saturated with water during most of the growing season. Slopes are 0 to 3 percent.

Included with this soil in mapping are areas of some deep sandy loam soils that are wet and saline. Also included are areas of Haverson silt loam, Glenberg soils, and marshes.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for irrigated pasture. (Capability units VIws–11, dryland, and IVws–11, irrigated; Saline Subirrigated range site, 10 to 14 inch precipitation zone)

Haverson clay loam (Hg).—This soil is on flood plains adjacent to stream channels along the major drainageways, mainly in the area of Sussex and along the Middle Fork of Powder River. It has a profile similar to the one described as representative of the series, except that the surface layer is clay loam 5 to 8 inches thick. Slopes are 0 to 3 percent.

Included with this soil in mapping are some areas where the surface layer is silty clay loam. Also included are areas of Haverson silt loam, Lohmiller soils, and Barnum soils. The Barnum soils are mainly along the Middle Fork of Powder River, above the town of Kaycee.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for irrigated hay, pasture, and small grain. (Capability units IVe–2, dryland, and IIs–16, irrigated; Clayey Overflow range site, 10 to 14 inch precipitation zone)

Haverson-Glenberg association (HH).—This association is about 45 percent Haverson loam, 0 to 3 percent slopes, and about 35 percent Glenberg sandy loam, 0 to 3 percent slopes. The Haverson soil has the profile described as representative of the Haverson series. Generally, the Glenberg soil is adjacent to the stream channel, and the Haverson soil is at the outermost edge of the landscape.

Included with these soils in mapping are areas of Bankard soils that make up about 10 percent of the acreage. Also included are areas of Haverson soils, sandy subsoil variant, that make up about 5 percent, gravel bars that make up about 5 percent, and stream channels that make up about 5 percent.

Runoff is slow, and the hazard of erosion is slight. If the cover is destroyed, the hazard of wind erosion is high on the Glenberg soil.

Soils of this association are used for range and wildlife habitat. (Haverson soil in capability unit IVe–2, dryland, and Glenberg soil in capability unit IVe–5, dryland. Both soils in Lowland range site, 10 to 14 inch precipitation zone)

Haverson-Glenberg association, saline (HK).—This association is about 50 percent Haverson loam, saline, 0 to 3 percent slopes, and about 25 percent Glenberg sandy loam, saline, 0 to 3 percent slopes. These soils have profiles similar to the ones described as representative of the Haverson and Glenberg series, except that they contain soluble salts. Also, they have a fluctuating water table. The accumulations of soluble salts are moderate. The water table fluctuates between depths of 20 to 40 inches, and the soils are moderately wet. These soils are on flood plains along major streams. Generally, the Glenberg soil is adjacent to the stream channel, and the Haverson soil is along the outer edge of the flood plain.

Runoff is slow, and the hazard of erosion is slight. If the cover is destroyed, the hazard of wind erosion is high on the Glenberg soil.

Soils of this association are used for range and as wildlife habitat. The vegetation is mainly inland saltgrass and alkali sacaton. (Both soils in capability unit VIws–11, dryland, and Saline Subirrigated range site, 10 to 14 inch precipitation zone)

Haverson Series, Sandy Subsoil Variant

The Haverson series, sandy subsoil variant, consists of nearly level, well-drained soils. These soils formed in alluvium on flood plains. Slopes range from 0 to 3 percent. Elevations range from 4,500 to 5,000 feet. The average annual precipitation is 10 to 14 inches, the average annual soil temperature is about 51° F., and the frost-free season is 105 to 120 days. The vegetation is western wheatgrass, silver sagebrush, blue grama, and cactus.

In a representative profile the surface layer is light brownish-gray, mildly alkaline silt loam about 7 inches thick. The underlying layer is light brownish-gray and light yellowish-brown, moderately alkaline loam or coarse sandy loam that is stratified with thin lenses of clay loam, sandy loam, and loamy sand.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more.

These soils are used for irrigated hay, pasture, and small grain.

Representative profile of Haverson silt loam, sandy subsoil variant, in the NW¼NW¼ sec. 33, T. 45 N., R. 78 W.

A1—0 to 7 inches, light brownish-gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; moderate, medium, granular structure; soft, very friable, slightly sticky and slightly plastic; many roots; mildly alkaline; clear, smooth boundary.

C1—7 to 26 inches, light brownish-gray (2.5Y 6/2) loam stratified with thin lenses of clay loam and sandy loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few roots; strong effervescence; moderately alkaline; clear, smooth boundary.

C2—26 to 60 inches, light yellowish-brown (2.5Y 6/4) coarse sandy loam stratified with lenses, 4 to 6 inches thick, of loamy sand and sandy loam, olive brown (2.5Y 4/4) moist; massive, but crushes to single grained; loose, very friable; strong effervescence; moderately alkaline.

These soils generally are calcareous throughout, but in places they are noncalcareous in the uppermost few inches. Content of coarse fragments typically is less than 5 percent. These soils range from mildly alkaline to strongly alkaline in reaction.

The A and C horizons range from 2.5Y to 10YR in hue, are 5 or 6 in value when dry and 4 or 5 when moist, and range from 2 to 4 in chroma when dry or moist.

Haverson silt loam, sandy subsoil variant (Hm).—This soil is on flood plains along the main streams. It is occasionally flooded. Slopes are 0 to 3 percent.

Included with this soil in mapping are other Haverson soils and Glenberg soils.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for irrigated hay, pasture, and small grain. (Capability units IVe–2, dryland, and IIe–2, irrigated; Lowland range site, 10 to 14 inch precipitation zone)

Hazton Series

The Hazton series consists of moderately steep or steep, well-drained soils. These soils formed in residuum derived from granite. These soils are on ridges and hillsides in the mountains. Slopes range from 10 to 40 percent. Elevations range from 7,500 to 9,500 feet. The average annual precipitation is 15 to 19 inches, the average annual soil temperature is about 40° F., and the average summer soil temperature is about 54° F. The frost-free season is about 65 days, although frost can occur during any month. The vegetation is Idaho fescue and flowering plants.

In a representative profile these soils are grayish-brown or brown, slightly acid gravelly coarse sandy loam that is underlain by granite bedrock at a depth of about 17 inches.

Permeability is moderately rapid, and the available water capacity is low. The effective rooting depth is 8 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Hazton gravelly coarse sandy loam, in an area of Hazton-Burgess association, a short distance north of the boundary of the survey area, in the SW¼NE¼ sec. 26, T. 47 N., R. 85 W.

A1—0 to 8 inches, grayish-brown (10YR 5/2) gravelly coarse sandy loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, granular structure; soft, very friable; 20 percent fine and very fine fragments of granite of pebble size; high percentage of medium and coarse granite sand; slightly acid; clear, smooth boundary.

C—8 to 17 inches, brown (10YR 5/3) gravelly coarse sandy loam, dark brown (10YR 4/3) moist; weak, coarse, subangular blocky structure; very hard, very friable; 25 percent fine and very fine angular fragments of granite of pebble size; high percentage of medium and coarse granite sand; slightly acid; abrupt, wavy boundary.

R—17 inches, granite bedrock.

Depth to bedrock ranges from 8 to 20 inches. These soils range from medium acid to mildly alkaline in reaction. Content of coarse fragments ranges from 0 to 35 percent but typically is more than 15 percent. The fragments are mainly fine and very fine, angular, granite pebbles.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. This horizon is soft or slightly hard when dry.

The C horizon ranges from 2.5Y to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist.

Hazton-Burgess association (HN).—This association is about 30 percent Hazton gravelly coarse sandy loam, 10 to 30 percent slopes; about 20 percent Hazton gravelly coarse sandy loam, 30 to 40 percent slopes; and about 30 percent Burgess gravelly coarse sandy loam, 10 to 20 percent slopes. The less steep Hazton soil and the Burgess soil have the profiles described as representative of the Hazton and Burgess series. The steeper Hazton soil has a profile similar to the one described as representative of the Hazton series, except that it is underlain by granite at a depth of 8 to 10 inches. These soils are on upland ridges and hillsides in the mountains.

Included with these soils in mapping are areas of Rock land that make up about 15 percent of the acreage and areas of other soils that make up 5 percent. These other soils are quite varied because in places the granite bedrock that underlies the Hazton and Burgess soils is thrust over or adjacent to limestone, sandstone, and other bedrock, in which a variety of soils formed.

Runoff is rapid, and the hazard of erosion is high.

Soils of this association are used for range and as wildlife habitat. (Both Hazton soils in capability unit VIIe–14, dryland; Hazton gravelly coarse sandy loam,

10 to 30 percent slopes, in Shallow Loamy range site, 15 to 19 inch precipitation zone, and Hazton gravelly coarse sandy loam, 30 to 40 percent slopes, in Very Shallow range site, 15 to 19 inch precipitation zone. Burgess soil in capability unit VIe–5, dryland, and Sandy range site, 15 to 19 inch precipitation zone)

Heldt Series

The Heldt series consists of well-drained soils. These soils formed in fine-textured alluvium on alluvial fans and foot slopes. Slopes range from 0 to 10 percent. Elevations range from 4,500 to 5,200 feet. The average annual precipitation is 10 to 12 inches, the average annual soil temperature is about 53° F., and the frost-free season is 105 to 110 days. The vegetation is western wheatgrass, green needlegrass, and big sagebrush.

In a representative profile the surface layer is light brownish-gray, mildly alkaline silty clay loam about 5 inches thick. The subsoil is light brownish-gray, mildly alkaline clay about 6 inches thick. The substratum is light brownish-gray, moderately alkaline clay that reaches to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is 50 to 60 inches or more.

These soils are used for range; for irrigated hay, pasture, and small grain; and as wildlife habitat.

Representative profile of Heldt silty clay loam, 0 to 3 percent slopes, 200 yards northeast of the hay corral on the old Gregg Homestead on Ninemile Creek, in NE¼SE¼ sec. 30, T. 44 N., R. 78 W.

A1—0 to 5 inches, light brownish-gray (2.5Y 6/2) silty clay loam, olive brown (2.5Y 4/3) moist; weak, medium, granular structure; extremely hard, very firm, very sticky and plastic; mildly alkaline; clear, smooth boundary.

B2—5 to 11 inches, light brownish-gray (2.5Y 6/2) clay, olive brown (2.5Y 4/3) moist; weak, coarse, angular blocky structure; extremely hard, very firm, very sticky and very plastic; mildly alkaline; gradual, smooth boundary.

C1ca—11 to 28 inches, light brownish-gray (2.5Y 6/2) clay, olive brown (2.5Y 4/3) moist; weak, coarse, angular blocky structure; extremely hard, very firm, very sticky and very plastic; few fine and medium seams and concretions of secondary calcium carbonate; strong effervescence; moderately alkaline; gradual, smooth boundary.

C2ca—28 to 60 inches, light brownish-gray (2.5Y 6/2) clay, olive brown (2.5Y 4/3) moist; massive; extremely hard, very firm, very sticky and very plastic; few fine concretions of secondary calcium carbonate; strong effervescence; moderately alkaline.

Depth to bedrock is 50 to 60 inches or more. Depth to carbonates generally ranges from 5 to 15 inches, but in many places these soils are calcareous to the surface. Content of coarse fragments typically is less than 5 percent. These soils range from neutral to strongly alkaline in reaction.

The A1 and B2 horizons range from 10YR to 2.5Y in hue, are 5 or 6 in value when dry and 4 or 5 when moist, and are 2 or 3 in chroma when dry or moist. The B2 horizon is silty clay loam or clay and the content of clay is 38 to 50 percent.

Heldt silty clay loam, 0 to 3 percent slopes (HoA).—This soil is on alluvial fans, mainly broad alluvial fans in the eastern part of the survey area. It has the profile described as representative of the series.

Included with this soil in mapping are some areas of Limon, Wyarno, and Stoneham soils.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for range; for irrigated hay, pasture, and small grain; and as wildlife habitat. (Capability units IVs–1, dryland, and IIIs–1, irrigated; Clayey range site, 10 to 14 inch precipitation zone)

Held silty lay loam, 6 to 10 percent slopes (HoC).—This soil is on alluvial fans. Included with this soil in mapping are some areas of Limon silty clay, Limon silty clay, saline, and Wyarno soils.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for irrigated hay, pasture, and small grain; for range; and as wildlife habitat. (Capability units IVe–1, dryland, and IIIe–1, irrigated; Clayey range site, 10 to 14 inch precipitation zone)

Heldt silty clay loam, 6 to 10 percent slopes (HoC.)—This soil is on alluvial fans and foot slopes. It has a profile similar to the one described as representative of the series, except that the surface layer is 1 to 2 inches thinner and the subsoil is 1 to 2 inches thinner.

Included with this soil in mapping are some areas of Gaynor, Limon, and Wyarno soils.

Runoff is rapid, and the hazard of water erosion is high.

This soil is used for range; for irrigated hay, pasture, and small grain; and as wildlife habitat. (Capability units VIe–1, dryland, and IVe–1, irrigated; Clayey range site, 10 to 14 inch precipitation zone)

Indart Series

The Indart series consists of moderately steep or steep, well-drained soils. These soils formed in residuum weathered from reddish-colored sandstone and shale in the mountains. They are on north-facing hillsides. Slopes range from 10 to 30 percent. Elevations range from 7,500 to 8,500 feet. The average annual precipitation is 15 to 19 inches, the average annual soil temperature is about 42° F., and the average summer soil temperature is about 56° F. The frost-free season is 65 to 70 days, although frost can occur during any month. The vegetation is Douglas-fir and lodgepole pine.

In a representative profile 4 inches of forest litter covers a surface layer of brown, medium acid fine sandy loam about 3 inches thick. The upper part of the subsurface layer is pink, medium acid fine sandy loam about 9 inches thick, and the lower part is mixed, light reddish-brown and red, medium acid sandy clay loam about 7 inches thick. The subsoil is light reddish-brown, medium acid sandy clay loam, about 13 inches thick, that is underlain by soft, reddish-brown sandstone at a depth of about 32 inches.

Permeability and the available water capacity are moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for woodland, wildlife habitat, and watershed.

Representative profile of Indart fine sandy loam in the SW¼SW¼ sec. 23, T. 45 N., R. 84 W.

O1—4 inches to 1 inch, undecomposed organic material, mainly needles, twigs, bark, and pine cones.

O2—1 inch to 0, partly decomposed organic material, mainly needles, twigs, bark, and pine cones.

A1—0 to 3 inches, brown (7.5YR 5/2) fine sandy loam, dark brown (7.5YR 3/2) moist; moderate, fine, crumb

structure; soft, very friable; 5 percent gravel; medium acid; diffuse, wavy boundary.

A2—3 to 12 inches, pink (5YR 7/3) sandy loam, reddish brown (5YR 5/4) moist; moderate, thin, platy structure parting to fine granular; soft, very friable; 5 percent gravel; medium acid; diffuse, wavy boundary.

A&B—12 to 19 inches, mixed colors including light reddish brown (5YR 6/4) and red (2.5YR 5/6) fine sandy clay loam, reddish brown (5YR 5/4) and red (2.5YR 4/6) moist; weak, medium, subangular blocky structure; slightly hard, very friable; few, thin, glossy patches on clayey ped faces; 5 percent gravel; this horizon consists of clayey material from the B2t horizon embedded in a light-colored matrix of material from the A2 horizon; medium acid; diffuse, wavy boundary.

B2t—19 to 32 inches, light reddish-brown (2.5YR 6/4) sandy clay loam, reddish brown (2.5YR 5/4) moist; moderate, medium, subangular blocky structure; hard, very friable; nearly continuous waxlike coatings on ped faces; waxlike coatings in root channels; 5 percent gravel; medium acid; abrupt, wavy boundary.

C—32 inches, soft, noncalcareous, reddish-brown sandstone.

Depth to bedrock ranges from 20 to 40 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 10 percent. The A1 horizon is lacking in some places.

The A2 horizon ranges from 7.5YR to 2.5YR in hue, is 6 or 7 in value when dry and 5 or 6 when moist, and ranges from 2 to 4 in chroma when dry or moist. It ranges from slightly acid to strongly acid. In most places the primary structure is platy, but in some places it is granular. This horizon is soft or slightly hard when dry.

The B2t horizon ranges from 5YR to 10R in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 3 to 6 in chroma when dry or moist. It ranges from slightly acid to strongly acid. It is sandy clay loam, sandy loam, or clay loam. More than 35 percent of the sand fraction is fine sand or coarser.

Indart fine sandy loam (IN).—This soil is on north-facing hillsides in the mountains. Areas of this soil generally are long and narrow, running east and west.

Included with this soil in mapping are some areas of Devoe and Tripit soils. Also included are some areas where as much as 25 percent of the acreage is reddish-colored soils that are similar to Indart soils. These soils differ from Indart soils in that bedrock is below a depth of 40 inches.

Runoff is rapid, and the hazard of erosion is high.

This soil is used for woodland, wildlife habitat, and watershed. The dominant tree species are Douglas-fir in unburned areas and lodgepole pine in burned-over areas. Woodland production includes posts, poles, and sawtimber. This soil is in woodland group 1. (Capability unit VIe-5, dryland; not in a range site)

Jenkinson Series

The Jenkinson series consists of moderately steep or steep, well-drained soils. These soils formed in residuum weathered from shale and sandstone on mountain hillsides. Slopes range from 10 to 30 percent. Elevations range from 8,000 to 9,000 feet. The average annual precipitation is 15 to 19 inches, the average annual soil temperature is about 40° F., and the average summer soil temperature is about 55° F. The frost-free season is 60 to 65 days, although frost can occur during any month. The vegetation is mountain sedges and grasses, but Idaho fescue is dominant.

In a representative profile the surface is grayish-brown, moderately alkaline channery clay loam about 8 inches thick. The underlying layer is light yellowish-brown, moderately alkaline channery clay loam about 6 inches thick that is underlain by hard bedrock at a depth of about 14 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is 10 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Jenkinson channery clay loam, in an area of Turk-Lymanson-Jenkinson association, in the NW¼NW¼ sec. 27, T. 45 N., R. 85 W.

A1—0 to 8 inches, grayish-brown (2.5Y 5/2) channery clay loam, very dark grayish brown (2.5Y 3/2) moist; moderate, very fine, granular structure; soft, very friable; 25 percent channery fragments; strong effervescence; moderately alkaline; clear, smooth boundary.

C—8 to 14 inches, light yellowish-brown (2.5Y 6/3) channery clay loam, olive brown (2.5Y 4/3) moist; very weak, medium, subangular blocky structure; slightly hard, very friable; 25 percent channery fragments; strong effervescence; moderately alkaline; gradual, wavy boundary.

R—14 inches, interbedded hard sandstone and slatelike, phylitic shale.

Depth to bedrock is 10 to 20 inches. These soils generally are calcareous throughout. Their profiles have texture of loam, clay loam, sandy clay loam, or silt loam. Content of coarse fragments ranges from 5 to 35 percent. The fragments are mostly slatelike channery fragments.

The A1 horizon ranges from 5Y to 10YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and ranges from 1 to 3 in chroma when dry or moist. In most places primary structure is granular or crumb, but in some places it is subangular blocky. This horizon is soft or slightly hard when dry.

The C horizon ranges from 5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 3 or 4 in chroma when dry or moist. It is moderately alkaline or strongly alkaline.

Jenkinson soils are mapped in an association with Lymanson and Turk soils.

Julesburg Series

The Julesburg series consists of nearly level to moderately steep, well-drained soils. These soils formed in alluvium derived from sandstone. They are on alluvial fans and foot slopes. Slopes range from 0 to 20 percent. Elevations range from 4,800 to 5,500 feet. The average annual precipitation is 12 to 14 inches, the average annual soil temperature is about 52° F., and the frost-free season is 105 to 110 days. The vegetation is needle-and-thread, blue grama, and big sagebrush.

In a representative profile the surface layer is brown, neutral sandy loam about 10 inches thick. The subsoil is yellowish-brown, mildly alkaline sandy loam about 22 inches thick. The substratum is light yellowish-brown, moderately alkaline sandy loam that reaches to a depth of 60 inches or more.

Permeability is moderately rapid, and the available water capacity is moderate. The effective rooting depth is 60 inches or more.

These soils are used for range, as wildlife habitat, and to a minor extent for irrigated hay, pasture, and small grain.

Representative profile of Julesburg sandy loam, in an area of Ascalon-Julesburg association, in the SE¼NW¼ sec. 18, T. 45 N., R. 81 W.

A1—0 to 6 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; weak, fine, granular structure; soft, very friable; neutral; abrupt, smooth boundary.

A3—6 to 10 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky; thin patchy to thin continuous clay films on vertical ped faces; soft, friable; neutral; clear, smooth boundary.

B2t—10 to 32 inches, yellowish-brown (10YR 5/4) sandy loam, dark brown (10YR 4/3) moist; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky; hard, friable; thin patchy to continuous clay films on ped faces; mildly alkaline; clear, smooth boundary.

C—32 to 60 inches, light yellowish-brown (10YR 6/4) sandy loam, yellowish brown (10YR 5/4) moist; weak, coarse, angular blocky structure; soft, friable; moderately alkaline; clear, smooth boundary.

Depth to calcareous material ranges from 50 to more than 60 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent.

The A horizon ranges from 10YR to 2.5Y in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. The A and B horizons are neutral or mildly alkaline.

The B2t horizon ranges from 10YR to 2.5Y in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist.

The C horizon ranges from 10YR to 2.5Y in hue. It is sandy loam or loamy sand.

Julesburg fine sandy loam (Ju).—This soil is on foot slopes and alluvial fans, mainly along the mountain flank. This soil has a profile similar to the one described as representative of the series, except that the surface layer is dark-gray, mildly alkaline fine sandy loam about 14 inches thick; the subsoil is brown, mildly alkaline sandy loam about 12 inches thick; and the substratum is brown, mildly alkaline sandy loam that reaches to a depth of 60 inches or more.

Included with this soil in mapping are some areas of Connerton, Kim, and La Fonda soils.

Runoff is slow to medium, and the hazard of water erosion is slight to moderate. If the soil is left bare, the hazard of wind erosion is high.

This soil is used for irrigated hay, pasture, and small grain. (Capability units IVe-5, dryland, and IIIs-5, irrigated; Sandy range site, 10 to 14 inch precipitation zone)

Keyner Series

The Keyner series consists of gently sloping to moderately steep, well-drained soils. These soils formed in alluvium derived from alkaline shale and sandstone. They are on alluvial fans and foot slopes. Slopes range from 3 to 15 percent. Elevations range from 4,500 to 5,500 feet. The average annual precipitation is 10 to 14 inches, the average annual soil temperature is about 52° F., and the frost-free season is 100 to 105 days. The vegetation is blue grama, cactus, and threadleaf sedge.

In a representative profile the surface layer is light-gray, moderately alkaline loamy sand about 6 inches thick. The upper part of the subsoil is grayish-brown, strongly alkaline or very strongly alkaline sandy clay loam about 12 inches thick, and the lower part is light brownish-gray, very strongly alkaline fine sandy loam about 8 inches thick. The substratum is light brownish-gray, very strongly alkaline fine sandy loam that reaches to a depth of 60 inches or more.

Permeability is slow to moderately slow, and the available water capacity is moderate. The effective rooting depth is 60 inches or more.

These soils are used for range and wildlife habitat. A few small areas of these soils that occur with other soils are irrigated. In irrigated areas the vegetation is typically Kochia weed.

Representative profile of Keyner loamy sand near the south quarter corner of sec. 24, T. 45 N., R. 83 W.

A2—0 to 6 inches, light-gray (2.5Y 7/1) loamy sand, gray (2.5Y 5/1) moist; weak, thick, platy structure parting to moderate, fine, granular; soft, very friable; moderately alkaline; abrupt, smooth boundary.

B21t—6 to 11 inches, grayish-brown (10YR 5/2) sandy clay loam, dark grayish brown (10YR 4/2) moist; moderate, coarse, columnar structure parting to moderate, coarse, angular blocky; very hard, very friable; many, thin, waxlike patches on ped faces; waxlike coatings in root channels; waxlike bridgings between sand grains; strongly alkaline; clear, wavy boundary.

B22t—11 to 18 inches, grayish-brown (2.5Y 5/2) sandy clay loam, dark grayish brown (2.5Y 4/2) moist; moderate, coarse, prismatic structure parting to moderate, coarse, angular blocky; very hard, very friable; many, thin, waxlike patches on ped faces; waxlike coatings in root channels; waxlike bridgings between sand grains; strong effervescence; very strongly alkaline; gradual, wavy boundary.

B3sa—18 to 26 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; moderate, coarse, subangular blocky structure; hard, very friable; few, thin, glossy patches on ped faces; waxlike bridgings between some sand grains; moderate accumulation of visible secondary salts occurring as concretions and crystals and in thin seams; strong effervescence; very strongly alkaline; gradual, wavy boundary.

Csa—26 to 60 inches, light brownish-gray (2.5Y 6/2) fine sandy loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, very friable; weak accumulation of secondary salts occurring as crystals and small concretions or in thin seams and streaks; strong effervescence; very strongly alkaline.

Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent.

The A2 horizon ranges from 2.5Y to 10YR in hue, is 6 or 7 in value when dry and 5 or 6 when moist, and ranges from 1 to 3 in chroma when dry or moist. It ranges from mildly alkaline to strongly alkaline. This horizon generally is noncalcareous, but in places it is weakly calcareous. In most places the primary structure is platy, but in some places it is granular or subangular blocky. This horizon is soft or slightly hard when dry.

The B2t horizon ranges from 5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 2 or 3 in chroma when dry or moist. It ranges from moderately alkaline to very strongly alkaline. In most places the primary structure is columnar, but in some places it is prismatic or blocky. Content of exchangeable sodium is less than 15 percent in the upper part of the B2t horizon but increases to more than 15 percent in the lower part. This horizon is sandy clay loam, sandy loam, loam, or clay loam.

The Csa horizon ranges from 5Y to 10YR in hue. It is strongly alkaline or very strongly alkaline. Content of exchangeable sodium ranges from 15 to 40 percent in the upper part of the C horizon, but it tends to decrease as depth increases.

Keyner complex, 3 to 10 percent slopes (KCC).—This complex is about 75 to 90 percent Keyner loamy sand, 3 to 10 percent slopes, intermingled in a complex pattern with various other soils. The Keyner soil has the profile described as representative of the Keyner series. These soils are on alluvial fans and foot slopes, mainly at the base of nearly barren uplifts of alkaline shale and sandstone.

Included with these soils in mapping are some areas of Bone, Zigweid, and Absted soils. Also included are some areas of Keyner soils that have a surface layer of sandy loam 6 to 14 inches thick.

Runoff is medium to rapid and the hazard of water erosion is moderate to high. If the cover is destroyed, the hazard of wind erosion is high.

Soils of this complex are used for range and wildlife habitat. A few small areas are irrigated along with adjoining soils in order to maintain good field alinement. (Capability units VIs–71, dryland, and VIs–71, irrigated; Loamy range site, 10 to 14 inch precipitation zone)

Kim Series

The Kim series consists of nearly level to moderately steep, well-drained soils. These soils formed in alluvium on alluvial fans. They are widely distributed throughout the survey area below the mountain front. Slopes range from 0 to 20 percent. Elevations range from 4,500 to 5,200 feet. The average annual precipitation is 10 to 14 inches, the average annual soil temperature is about 52° F., and the frost-free season is 105 to 110 days. The vegetation is western wheatgrass, blue grama, big sagebrush, and cactus.

In a representative profile the surface layer is light brownish-gray, moderately alkaline loam about 5 inches thick. The underlying layer is pale-yellow, moderately alkaline silt loam that reaches to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more.

These soils are used for range, for irrigated hay, pasture, and small grain, and as wildlife habitat.

Representative profile of Kim loam, 0 to 3 percent slopes, in the SW¼SW¼ sec. 7, T. 46 N., R. 77 W.

A1—0 to 5 inches, light brownish-gray (2.5Y 6/2) loam, light olive brown (2.5Y 5/4) moist; weak, medium, crumb structure; slightly hard, friable; many roots; strong effervescence; moderately alkaline; clear, smooth boundary.

AC—5 to 18 inches, pale-yellow (2.5Y 7/4) silt loam, light olive brown (2.5Y 5/4) moist; weak, coarse, angular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; few roots; strong effervescence; moderately alkaline; clear, smooth boundary.

Cca—18 to 60 inches, pale-yellow (2.5Y 7/4) silt loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many nodules of precipitated carbonates on ped faces and in pores; strong effervescence; moderately alkaline.

These soils generally are calcareous to the surface, but in places they are noncalcareous in the uppermost 2 to 4 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 10 percent. The C horizon generally has some visible secondary calcium carbonate, but it does not consistently have secondary carbonate accumulation.

The A horizon ranges from 10YR to 5Y in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It is mildly alkaline or moderately alkaline.

The C horizon ranges from 10YR to 5Y in hue, ranges from 5 to 7 in value when dry and from 4 to 6 when moist, and ranges from 3 to 5 in chroma when dry or moist. It is moderately alkaline or strongly alkaline silt loam, loam, or clay loam.

Kim loam, 0 to 3 percent slopes (KdA).—This soil is on alluvial fans, mainly in the lower parts of valleys just above stream bottoms. It has the profile described as representative of the series.

Included with this soil in mapping are small areas of Kim clay loam and some areas of Stoneham and Zigweid soils.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for irrigated hay, pasture, and small grain. (Capability units IVe–2, dryland, and IIe–2, irrigated; Loamy range site, 10 to 14 inch precipitation zone)

Kim loam, 3 to 6 percent slopes (KdB).—This soil is on alluvial fans. Included with this soil in mapping are small areas of Kim clay loam and some areas of Stoneham and Zigweid soils.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for irrigated hay, pasture, and small grain. (Capability units IVe–2, dryland, and IIIe–2, irrigated; Loamy range site, 10 to 14 inch precipitation zone)

Kim loam, 6 to 10 percent slopes (KdC).—This soil is on alluvial fans and foot slopes, mainly at the base of adjacent uplands. Included with this soil in mapping are some areas of Cushman, Shingle, and Zigweid soils.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used for irrigated hay, pasture, and small grain. (Capability units VIe–2, dryland, and IVe–2, irrigated; Loamy range site, 10 to 14 inch precipitation zone)

Kim loam, wet (Ke).—This soil is on alluvial fans. It has a profile similar to the one described as representative of the series, except that it has an accumulation of soluble salts. Also, this soil has a fluctuating water table. The salt content is moderate. The fluctuating water table is at or near the surface during part of the growing season. Slopes are 0 to 3 percent.

Included with this soil in mapping are areas of Kim loam and Zigweid soils and areas that are strongly saline and wet.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for irrigated pasture. (Capability units VIws–10, dryland, and IVws–10, irrigated; Saline Subirrigated range site, 10 to 14 inch precipitation zone)

Kim-Haverson association (KH).—This association is about 50 percent Kim loam, 3 to 6 percent slopes, and about 30 percent Haverson loam, 0 to 3 percent slopes. These soils occupy flood plains and alluvial fans adjacent to the bottoms. The Kim soil is on alluvial fans that border the stream bottoms, and the Haverson soil is on flood plains.

Included with these soils in mapping are areas of Limon soils that make up about 10 percent of the acreage. Also included are areas of Glenberg soils that make up about 5 percent and areas of stream channels and side draws that make up about 5 percent.

Runoff is medium on the Kim soil and slow on the Haverson soil. The hazard of erosion is moderate on the Kim soil and slight on the Haverson soil.

Soils of this association are used for range and wildlife habitat. (Capability unit IVe–2, dryland. Kim soil

in Loamy range site, 10 to 14 inch precipitation zone, and Haverson soil in Overflow range site, 10 to 14 inch precipitation zone)

Kim-Travessilla association (KT).—This association is about 50 percent Kim loam, 10 to 20 percent slopes, and about 30 percent Travessilla sandy loam, 15 to 40 percent slopes. These soils generally are on ridges, hillsides, and alluvial fans. The Kim soil has a profile similar to the one described as representative of the Kim series, except that in some places the surface layer is redder or grayer.

Included with these soils in mapping are areas of Sunup soils that make up about 10 percent of the acreage. Also included are areas of Ascalon soils that make up about 5 percent and areas of Shale outcrop that make up about 5 percent.

Runoff is rapid, and the hazard of erosion is high. If the soil is left bare, the hazard of wind erosion is high on the Travessilla soil.

Soils of this association are used for range and wildlife habitat. (Kim soil in capability unit VIe–2, dryland, and Loamy range site, 10 to 14 inch precipitation zone. Travessilla soil in capability unit VIIe–14, dryland, and Shallow Sandy range site, 10 to 14 inch precipitation zone)

Kim-Zigweid association, gently sloping (KZB).—This association is about 50 percent Kim loam, 0 to 6 percent slopes, and about 30 percent Zigweid loam, 0 to 6 percent slopes. These soils are on alluvial fans.

Included with these soils in mapping are areas of Stoneham soils that make up about 15 percent of the acreage and areas of Limon soils that make up about 5 percent.

Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Soils of this association are used for range and wildlife habitat. (Capability unit IVe–2, dryland; Loamy range site, 10 to 14 inch precipitation zone)

Kim-Zigweid association, moderately steep (KZD).—This association is about 40 percent Kim loam, 6 to 20 percent slopes, and about 30 percent Zigweid loam, 6 to 20 percent slopes. The Zigweid soil has the profile described as representative of the Zigweid series. These soils occupy alluvial fans on the sides of valleys. The Kim soil is on the upper parts at the outer edge of the valleys, and the Zigweid soil is on the lower parts of the landscape.

Included with these soils in mapping are areas of Stoneham soils that make up about 20 percent of the acreage. Also included are areas of Shingle soils that make up about 5 percent and areas of Worf soils that make up about 5 percent.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

Soils of this association are used for range and wildlife habitat. (Capability unit IVe–2, dryland; Loamy range site, 10 to 14 inch precipitation zone)

Kirtley Series

The Kirtley series consists of sloping or moderately steep, well-drained soils. These soils formed in residuum derived from reddish-colored siltstone and shale. They are on uplands. Slopes range from 6 to 15 percent. Elevations range from 5,000 to 6,000 feet. The average annual precipitation is 12 to 14 inches, the average annual soil temperature is about 51° F., and the frost-free season is 95 to 100 days. The vegetation is western wheatgrass, needle-and-thread, big sagebrush, and blue grama.

In a representative profile the surface layer is brown, mildly alkaline loam about 4 inches thick. The upper part of the subsoil is reddish-brown, mildly alkaline loam or clay loam about 12 inches thick, and the lower part is reddish-brown, moderately alkaline loam about 6 inches thick. The substratum is reddish-brown, moderately alkaline loam, about 8 inches thick, that is underlain by shale at a depth of about 30 inches.

Permeability and the available water capacity are moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Kirtley loam, in an area of Harlan-Kirtley association, near the center of sec. 27, T. 44 N., R. 83 W.

A1—0 to 4 inches, brown (7.5YR 5/3) loam, dark brown (7.5YR 3/3) moist; strong, fine, granular structure; soft, very friable; mildly alkaline; clear, wavy boundary.

B1—4 to 7 inches, reddish-brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; medium prismatic structure parting to moderate, medium, subangular blocky; slightly hard, very friable; peds are hard; few, thin, glossy patches on ped faces; mildly alkaline; clear, wavy boundary.

B21t—7 to 11 inches, reddish-brown (5YR 4/3) clay loam, dark reddish brown (5YR 3/3) moist; moderate, medium, prismatic structure parting to strong, medium, subangular blocky; hard, very friable; peds are very hard; thin, continuous, waxlike coatings on ped faces; waxlike coatings in root channels and pores; mildly alkaline; clear, wavy boundary.

B22t—11 to 16 inches, reddish-brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate, medium, prismatic structure parting to strong, medium, subangular blocky; hard, friable; peds are very hard; thin, continuous, waxlike coatings on ped faces; thin waxlike coatings in root channels; mildly alkaline; clear, wavy boundary.

B3ca—16 to 22 inches, reddish-brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky; hard, very friable; peds are very hard; few, thin, glossy patches on ped faces and on inside of pores; some visible calcium carbonate occurring as concretions; strong effervescence; moderately alkaline; gradual, wavy boundary.

Cca—22 to 30 inches, reddish-brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; massive; hard, very friable; visible secondary calcium carbonate occurring as concretions and in thin seams and streaks; strong effervescence; moderately alkaline; gradual, wavy boundary.

IIC—30 inches, reddish-brown, calcareous shale and some interbedded olive shale.

Depth to bedrock ranges from 20 to 40 inches, depth to calcareous material ranges from 6 to 20 inches, and thickness of the solum ranges from 15 to 30 inches.

The A1 horizon ranges from 5YR to 7.5YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. Its neutral or mildly alkaline. In most places the primary structure is fine and granular, but in some places it is subangular blocky. This horizon is soft or slightly hard when dry.

The B21t horizon is 2.5YR or 5YR in hue, 4 or 5 in value when dry and 2 or 3 when moist, and 2 or 3 in chroma when dry or moist. The B22t horizon is 2.5YR or 5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 3 to 5 in chroma when dry or moist. It is mildly alkaline or moderately alkaline. In most places primary structure is prismatic, but in some places it is subangular blocky.

The Cca horizon ranges from 5YR to 10R in hue. It is moderately alkaline or strongly alkaline. The calcium carbonate equivalent ranges from about 5 to 12 percent.

Kirtley soils are mapped in associations with Harlan, Moret, and Potts soils.

La Fonda Series

The La Fonda series consists of gently sloping to moderately steep, well-drained soils. These soils formed in reddish-colored alluvium derived from red beds. They are on alluvial fans. Slopes range from 3 to 15 percent. Elevations range from 5,000 to 5,500 feet. The average annual precipitation is 12 to 14 inches, the average annual soil temperature is about 50° F., and the frost-free season is 90 to 95 days. The vegetation is western wheatgrass, blue grama, and big sagebrush.

In a representative profile the surface layer is reddish-brown, neutral very fine sandy loam about 2 inches thick. The upper part of the subsoil is reddish-brown, mildly alkaline loam about 3 inches thick, and the lower part is light reddish-brown, moderately alkaline very fine sandy loam about 8 inches thick. The substratum is light reddish-brown or reddish-brown, moderately alkaline very fine sandy loam that reaches to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more.

These soils are used for range and wildlife habitat.

Representative profile of La Fonda very fine sandy loam, in an area of Connerton-La Fonda association, 150 yards east and 100 yards south of the west quarter corner, sec. 30, T. 42 N., R. 83 W.

A1—0 to 2 inches, reddish-brown (5YR 5/4) very fine sandy loam, dark reddish brown (5YR 3/4) moist; moderate, thin, platy structure parting to weak, fine, crumb; soft, very friable; many roots; neutral; clear, smooth boundary.

B2—2 to 5 inches, reddish-brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; weak prismatic structure parting to moderate, fine, subangular blocky; indistinct clay films; soft, very friable, slightly sticky; mildly alkaline; gradual, wavy boundary.

B3—5 to 13 inches, light reddish-brown (5YR 6/3) very fine sandy loam, reddish brown (5YR 4/4) moist; weak, fine to medium, subangular blocky structure; slightly hard, very friable, slightly sticky; few roots; moderate effervescence; moderately alkaline; clear, smooth boundary.

C1ca—13 to 52 inches, light reddish-brown (5YR 6/4) very fine sandy loam, reddish brown (5YR 5/4) moist; massive; slightly hard, very friable; many fine lime concretions; violent effervescence; moderately alkaline; clear, smooth boundary.

C2ca—52 to 60 inches, reddish-brown (5YR 5/4) very fine sandy loam, reddish brown (5YR 4/4) moist; structureless; slightly hard, friable, slightly sticky; many fine threads of calcium carbonate; moderate effervescence; moderately alkaline.

Content of coarse fragments ranges from 0 to 15 percent but generally is less than 5 percent.

The A1 horizon ranges from 7.5YR to 2.5YR in hue, is 4 or 5 in value when dry and 3 or 4 when moist, and ranges from 2 to 4 in chroma when dry or moist. The A1 horizon has a maximum thickness of about 4 inches. It is neutral or mildly alkaline.

The B2 horizon ranges from 7.5YR to 2.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 3 to 5 in chroma when dry or moist. It ranges from neutral to moderately alkaline. This horizon is loam or clay loam.

The Cca horizon ranges from 7.5YR to 2.5YR in hue. It is moderately alkaline or strongly alkaline.

La Fonda-Harlan association (LA).—This association is about 40 percent La Fonda very fine sandy loam, 3 to 15 percent slopes, and about 30 percent Harlan loam, 3 to 15 percent slopes. In areas at the base of the Horn in Ts. 45 and 46 N., R. 83 W., the La Fonda and Harlan soils, in places, have a surface layer of gravelly and cobbly material. These soils occupy alluvial fans and foot slopes. The La Fonda soil is on the upper parts of the landscape, and the Harlan soil is on the lower foot slopes and alluvial fans.

Included with these soils in mapping are areas of Connerton soils that make up about 20 percent of the acreage. Also included are areas of Spearfish soils that make up about 5 percent and areas of dark-colored sandy loam soils that make up about 5 percent. In the valley that runs along the western flank of E K mountain, these dark-colored sandy loam soils make up as much as 20 percent of the acreage. Also included, on some ridges that extend from the Horn, are very gravelly and very stony soils.

Runoff is medium to rapid, and the hazard of water erosion is moderate to high. If the cover is destroyed, the hazard of wind erosion is high on the La Fonda soil.

Soils of this association are used for range and wildlife habitat. (Capability unit VIe–2, dryland; Loamy range site, 10 to 14 inch precipitation zone)

Leavitt Series

The Leavitt series consists of well-drained soils. These soils formed in alluvium derived from limestone. They are on alluvial foot slopes. Slopes range from 6 to 20 percent. Elevations range from 7,500 to 9,000 feet. The average annual precipitation is 16 to 19 inches, the average annual soil temperature is about 42° F., and the average summer soil temperature is about 53° F. The frost-free season is 65 to 70 days, although frost can occur in any month. The vegetation is mountain grasses and sedges, and Idaho fescue is dominant.

In a representative profile the surface layer is dark grayish-brown, neutral loam about 4 inches thick. The upper part of the subsoil is dark-brown, mildly alkaline clay loam about 8 inches thick, and the lower part is yellowish-brown, strongly alkaline clay loam about 9 inches thick. The substratum is pale-brown, moderately alkaline or strongly alkaline loam that reaches to a depth of 60 inches or more.

Permeability is moderate, and throughout the profile the available water capacity is high. The effective rooting depth is 50 to 60 inches or more.

These soils are used for range and wildlife habitat.

Representative profile of Leavitt loam, in an area of Leavitt-Passcreek association, 960 feet south-southwest of the south quarter corner of sec. 25, T. 42 N., R. 85 W.

A1—0 to 4 inches, dark grayish-brown (10YR 4/2) loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, crumb structure; soft, very friable, slightly sticky; many roots; neutral; clear, smooth boundary.

B2t—4 to 12 inches, dark-brown (10YR 4/3) clay loam, dark brown (10YR 3/3) moist; weak, medium, prismatic structure parting to moderate, medium, subangular

blocky; thick nearly continuous clay films; slightly hard, friable, sticky and plastic; many roots; 5 percent or less ¼- to ¾-inch sandstone fragments; mildly alkaline; clear, smooth boundary.

B3ca—12 to 21 inches, yellowish-brown (10YR 5/4) clay loam, dark brown (10YR 4/3) moist; weak, fine, angular blocky structure; thin discontinuous clay films on vertical surfaces; slightly hard, friable, sticky and plastic; few roots; many medium threads and spots of secondary calcium carbonate; 5 to 10 percent ¼- to 1-inch, lime-coated sandstone fragments; violent effervescence; strongly alkaline; clear, smooth boundary.

C1ca—21 to 41 inches, pale-brown (10YR 6/3) and spots of light-gray (10YR 7/2) loam, brown (10YR 5/3) moist; structureless; slightly hard, friable, sticky and plastic; few roots; many fine and medium threads and spots of secondary lime; 5 to 10 percent ¼- to 1-inch, lime-coated sandstone fragments; violent effervescence; moderately alkaline; gradual, wavy boundary.

C2ca—41 to 60 inches, pale-brown (10YR 6/3) loam that has fine concretions of light gray (10YR 7/2), brown (10YR 5/3) moist; structureless; slightly hard, friable, sticky and plastic; many fine and medium threads and nodules of secondary lime; 10 to 15 percent 1- to 3-inch, lime-coated sandstone fragments; violent effervescence; strongly alkaline.

In most places depth to bedrock is more than 60 inches, but it ranges from 50 inches to more than 60 inches. Depth to calcareous material ranges from 10 to 24 inches. Content of coarse fragments ranges from 5 to 20 percent but typically is about 10 percent. A few stones may occur in the C horizon.

The A1 horizon ranges from 10YR to 7.5YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. It is loam or clay loam. The A1 and B2t horizons are neutral or mildly alkaline.

The B2t horizon ranges from 10YR to 7.5YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. It is loam or clay loam.

The B3ca and C horizons range from 2.5Y to 7.5YR in hue. They are moderately alkaline or strongly alkaline.

Leavitt-Passcreek association (LE).—This association is about 45 percent Leavitt loam, 6 to 20 percent slopes, and about 30 percent Passcreek loam, 6 to 20 percent slopes. The Leavitt soil has the profile described as representative of the Leavitt series. These soils occupy valleys and hillsides. The Leavitt soil is on alluvial foot slopes, and the Passcreek soil is on hillsides.

Included with these soils in mapping are areas of Splitro soils that make up about 15 percent of the acreage. Also included are areas of Decross soils that make up about 5 percent and areas of Sublette soils that make up about 5 percent.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

Soils of this association are used for range and wildlife habitat. (Capability unit VIe-2, dryland; Loamy range site, 15 to 19 inch precipitation zone)

Limon Series

The Limon series consists of nearly level to moderately steep, well-drained soils. These soils formed in fine-textured alluvium on alluvial fans and foot slopes. Slopes range from 0 to 20 percent. Elevations range from 4,500 to 5,200 feet. The average annual precipitation is 11 to 12 inches, the average annual soil temperature is about 53° F., and the frost-free season is 100 to 105 days. The vegetation is western wheatgrass and big sagebrush.

In a representative profile the surface layer is light-gray, moderately alkaline silty clay about 4 inches thick. The underlying layer is light yellowish-brown or pale-yellow, strongly alkaline silty clay that reaches to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is 60 inches or more.

These soils are used for range, for irrigated hay pasture, and small grain, and for limited dryfarming.

Representative profile of Limon silty clay, in an area of Limon-Cadoma association, in the NE¼SW¼ sec. 17, T. 45 N., R. 80 W.

A1—0 to 4 inches, light-gray (2.5Y 7/2) silty clay, light olive brown (2.5Y 5/4) moist; strong, fine, granular structure; hard, firm, sticky and plastic; many roots; moderately alkaline; abrupt, smooth boundary.

C1—4 to 17 inches, light yellowish-brown (2.5Y 6/4) silty clay, light olive brown (2.5Y 5/4) moist; weak, medium, subangular blocky structure; hard, firm, sticky and plastic; many roots in upper 4 inches, few roots below; strong effervescence; strongly alkaline; clear, smooth boundary.

C2—17 to 28 inches, light yellowish-brown (2.5Y 6/4) silty clay, light olive brown (2.5Y 5/4) moist; weak, medium, subangular blocky structure; hard, firm, sticky and plastic; strong effervescence; strongly alkaline; clear, smooth boundary.

C3ca—28 to 60 inches, pale-yellow (2.5Y 7/4) silty clay, light yellowish brown (2.5Y 6/4) moist; massive; hard, friable, slightly sticky and slightly plastic; many splotches of carbonates; violent effervescence; strongly alkaline.

Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent. The A and C horizons are moderately alkaline or strongly alkaline.

The A1 horizon ranges from 5Y to 10YR in hue, is 5 to 7 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist.

The C horizon ranges from 10YR to 5Y in hue, ranges from 5 to 7 in value when dry and is 5 or 6 when moist, and ranges from 2 to 4 in chroma when dry or moist. It is mainly silty clay loam or silty clay and has a clay content of 35 to 50 percent. In some profiles the lower part of the C horizon is clay loam that is 30 to 35 percent clay.

Limon silty clay, 0 to 3 percent slopes (LmA).—This soil is on alluvial fans, generally immediately above stream bottoms. It has a profile similar to the one described as representative of the series, except that the surface layer is 6 inches thick.

Included with this soil in mapping are some areas of Heldt, Wyarno, and Stoneham soils.

Runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for irrigated hay, pasture, and small grain and to a minor extent for dryland spring wheat and hay. (Capability units IVs-1, dryland, and IIIs-1, irrigated; Clayey range site, 10 to 14 inch precipitation zone)

Limon silty clay, 3 to 6 percent slopes (LmB).—This soil is on alluvial fans. It has a profile similar to the one described as representative of the series, except that the surface layer is 6 inches thick.

Included with this soil in mapping are some sizable areas of Razor silty clay loam. Also included are areas of Gaynor and Wyarno soils.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for range, for dryland spring wheat and hay, and to a lesser extent for irrigated hay, pasture, and small grain. (Capability units IVe-1, dryland. and

IIIe–1, irrigated; Clayey range site, 10 to 14 inch precipitation zone)

Limon silty clay, saline, 0 to 6 percent slopes (LnB).—soil is on alluvial fans. Included with this soil in mapping are some sizable areas of Gaynor silty clay. Also included are areas of Razor and Wyarno soils.

Runoff is rapid, and the hazard of erosion is high.

This soil is used for irrigated hay, pasture, and small grain and for range. (Capability units VIe–1, dryland, and IVe–1, irrigated; Clayey range site, 10 to 14 inch precipitation zone)

Limon silty clay, saline, 0 to 6 percent slopes (LnB).—This soil is on alluvial fans. It has a profile similar to the one described as representative of the series, except that the surface layer is dark grayish brown, the substratum is grayish brown, and it has an accumulation of soluble salts. This soil is moderately saline to strongly saline and contains many threads and nodules of soluble salts throughout the profile.

Included with this soil in mapping are some areas of Bone, Petrie, and Limon soils.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used for irrigated hay and pasture and, to a lesser extent, for range. (Capability units VIs–71, dryland, and IVs–12, irrigated; Saline Lowland range site, 10 to 14 inch precipitation zone)

Limon silty clay, saline, 6 to 10 percent slopes (LnC).—This soil is on alluvial fans and in valleys. It has a profile similar to the one described as representative of the series, except that the surface layer is dark grayish brown. The soil has an accumulation of soluble salts. It is moderately saline to strongly saline and contains threads and nodules of soluble salts throughout the profile.

Included with this soil in mapping are some areas of Bone, Petrie, and Limon soils.

Runoff is rapid, and the hazard of erosion is high.

This soil is used for irrigated hay and pasture and, to a lesser extent, for range. (Capability units VIe–71, dryland, and IVs–12, irrigated; Saline Lowland range site, 10 to 14 inch precipitation zone)

Limon-Cadoma association (LO).—This association consists of about 30 percent Limon silty clay, 0 to 10 percent slopes; about 30 percent Cadoma silty clay loam, 3 to 10 percent slopes; and about 20 percent Wyarno clay loam, 0 to 10 percent slopes. The Limon soil has the profile described as representative of the Limon series. These soils occupy alluvial fans. The Limon and Wyarno soils are intermingled on the lower end of alluvial fans, and the Cadoma soil is on the upper parts of the landscape.

Included with these soils in mapping are areas of Orella soils that make up about 15 percent of the acreage and areas of Petrie soils that make up about 5 percent.

Runoff is slow to rapid on the Limon and Wyarno soils and medium to rapid on the Cadoma soil. The hazard of erosion is slight to high on the Limon and Wyarno soils and moderate to high on the Cadoma soil.

Soils of this association are used for range and wildlife habitat. (Limon soil in capability unit VIe–1, dryland, and Clayey range site, 10 to 14 inch precipitation zone. Cadoma soil in capability unit VIe–71, dryland, and Dense Clay range site, 10 to 14 inch precipitation zone. Wyarno soil in capability unit IVe–1, dryland, and Clayey range site, 10 to 14 inch precipitation zone)

Limon-Gaynor association (LR).—This association is about 40 percent Limon silty clay, 6 to 20 percent slopes; about 25 percent Gaynor silty clay, 6 to 20 percent slopes; and about 20 percent Samsil silty clay, 10 to 30 percent slopes. These soils occupy upland ridges and alluvial foot slopes. The Limon soil is on foot slopes, the Gaynor soil is on uplands above the Limon soil, and the Samsil soil is on ridges.

Included with these soils in mapping are areas of Razor soils that make up about 10 percent of the acreage and areas of Heldt soils that make up about 5 percent.

Runoff is rapid, and the hazard of erosion is high.

Soils of this association are used for range and wildlife habitat. (Limon and Gaynor soils in capability unit VIe–1, dryland, and Clayey range site, 10 to 14 inch precipitation zone. Samsil soil in capability unit VIIe–14, dryland, and Shallow Clayey range site, 10 to 14 inch precipitation zone)

Lohmiller Series

The Lohmiller series consists of nearly level, moderately well drained soils. These soils formed in clayey alluvium on flood plains. Slopes range from 0 to 3 percent. Elevations range from 4,500 to 5,000 feet. The average annual precipitation is 12 to 13 inches, the average annual soil temperature is about 53° F., and the frost-free season is 105 to 110 days. The vegetation is western wheatgrass and big sagebrush.

In a representative profile the surface layer is light olive-gray, moderately alkaline silty clay loam about 3 inches thick. The underlying layer is pale-olive, moderately alkaline silty clay loam that is stratified with loam, sandy loam, and clay loam in lenses 2 to 5 inches thick. This material reaches to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is 60 inches or more.

These soils are used for irrigated hay, pasture, and small grain; small areas are used for range.

Representative profile of Lohmiller silty clay loam in the SW¼NE¼ sec. 18, T. 43 N., R. 79 W.

A1—0 to 3 inches, light olive-gray (5Y 6/2) silty clay loam, olive gray (5Y 4/2) moist; moderate, medium, granular structure; hard, firm, sticky and plastic; many roots; slight effervescence; moderately alkaline; abrupt, smooth boundary.

C—3 to 60 inches, pale-olive (5Y 6/3) silty clay loam, olive (5Y 4/3) moist; stratified with lenses of loam, sandy loam, and clay loam 2 to 5 inches thick; massive; hard, firm, sticky and plastic; few roots; strong effervescence; moderately alkaline.

The A and C horizons are silty clay loam, clay loam, or silty clay, and the clay content is about 35 to 50 percent. In some profiles coarse sandy material is at a depth of more than 40 inches. The A and C horizons range from 10YR to 5Y in hue, range from 5 to 7 in value when dry and are 4 or 5 when moist, and range from 2 to 4 in chroma when dry or moist. These soils generally are calcareous to the surface, but in places the A1 horizon is noncalcareous. In cultivated areas, the Ap horizon typically is calcareous. These soils range from mildly alkaline to strongly alkaline. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent.

Lohmiller silty clay loam (Ls).—This soil is on flood plains, mainly along the Middle Fork of Powder River. It is occasionally flooded. Slopes are 0 to 3 percent.

Included with this soil in mapping are areas of soils that have a surface layer of reddish-colored silt loam and areas of soils that are similar to this Lohmiller soil, except that the substratum is sandy below a depth of 40 inches. Also included are some areas of Barnum and Haverson soils and fine-textured, noncalcareous soils on alluvial fans.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for irrigated hay, pasture, and small grain. (Capability units IVs–1, dryland, and IIIs–1, irrigated; Clayey Overflow range site, 10 to 14 inch precipitation zone)

Lohsman Series

The Lohsman series consists of gently sloping to moderately steep, well-drained soils. These soils formed in residuum weathered from alkaline shale on hillsides. Slopes range from 3 to 15 percent. Elevations range from 4,500 to 5,000 feet. The average annual precipitation is 11 to 12 inches, the average annual soil temperature is about 52° F., and the frost-free season is 105 to 110 days. The vegetation is western wheatgrass, blue grama, big sagebrush, and cactus.

In a representative profile the surface layer is light-gray, neutral fine sandy loam about 4 inches thick. The upper part of the subsoil is brown, moderately alkaline to very strongly alkaline clay about 9 inches thick, and the lower part is light olive-brown, very strongly alkaline clay loam about 5 inches thick. The substratum is light olive-brown, very strongly alkaline clay loam, about 8 inches thick, that is underlain by shale at a depth of about 26 inches.

Permeability is slow, and the available water capacity is low. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Lohsman fine sandy loam, in an area of Briggsdale-Lohsman complex, rolling, in the NW¼SE¼ sec. 31, T. 45 N., R. 79 W.

A2—0 to 4 inches, light-gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) moist; weak, medium, platy structure parting to moderate, fine, granular; soft, very friable; neutral; abrupt, smooth boundary.

B21t—4 to 9 inches, brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; strong, medium, columnar structure parting to strong, medium, angular blocky; slightly hard, very friable, very plastic; peds are extremely hard; moderate, continuous, waxlike coatings on ped faces; waxlike coatings and fillings in root channels; moderately alkaline; gradual, wavy boundary.

B22t—9 to 13 inches, brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; moderate, medium, prismatic structure parting to strong, medium, angular blocky; slightly hard, very friable, very plastic; peds are extremely hard; moderate, continuous, waxlike coatings on ped faces; waxlike coatings and fillings in root channels; strong effervescence; very strongly alkaline; gradual, wavy boundary.

B3sa—13 to 18 inches, light olive-brown (2.5Y 5/3) clay loam, olive brown (2.5Y 4/3) moist; moderate, medium, angular blocky structure; very hard, very plastic; moderate, thin, waxlike patches on ped faces; some glossy coatings on inside of root channels; some accumulation of secondary salts occurring as concretions and crystals; strong effervescence; very strongly alkaline; gradual, wavy boundary.

C1sa—18 to 26 inches, light olive-brown (2.5Y 5/4) clay loam, olive brown (2.5Y 4/4) moist; massive; hard, very friable; moderate accumulation of secondary salts occurring as concretions, crystals, and thin seams; violent effervescence; very strongly alkaline; gradual, wavy boundary.

C2—26 inches, calcareous, strongly alkaline or very strongly alkaline shale.

Depth to bedrock ranges from 20 to 40 inches. The content of exchangeable sodium typically is 4 to 8 percent in the upper part of the solum, but it ranges from 15 to 30 percent in the lower part. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 2 percent. Some profiles have a thin A1 horizon, and some do not have an A2 horizon because the soil is eroded.

The A2 horizon ranges from 2.5Y to 10YR in hue, is 6 or 7 in value when dry and 5 or 6 when moist, and is 2 or 3 in chroma when dry or moist. It ranges from medium acid to mildly alkaline. This horizon generally is noncalcareous, but in places it is weakly calcareous. In most places the primary structure is platy, but in some places it is granular or subangular blocky. This horizon is soft or slightly hard when dry.

The B2t horizon ranges from 2.5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It ranges from moderately alkaline to very strongly alkaline. In most places the primary structure is columnar, but in some places it is prismatic blocky.

The Csa horizon ranges from 5Y to 10YR in hue. It is strongly alkaline or very strongly alkaline.

Lohsman-Orella complex, hilly (LTD).—This complex is about 40 percent Lohsman fine sandy loam, 3 to 15 percent slopes; about 25 percent Orella silty clay, 6 to 20 percent slopes; and about 15 percent Absted very fine sandy loam, 0 to 10 percent slopes. The Orella soil has the profile described as representative of the Orella series. These soils occupy uplands and alluvial fans. The Lohsman soil is on hillsides, the Orella soil is on crests of upland ridges, and the Absted soil is on alluvial fans on the lower parts of the landscape.

Included with these soils in mapping are areas of Briggsdale soils that make up about 10 percent of the acreage and areas of Cushman soils that make up about 5 percent.

Runoff is slow to rapid on the Lohsman soil, rapid on the Orella soil, and slow to medium on the Absted soil. The hazard of water erosion is slight to high on the Lohsman soil, high on the Orella soil, and slight to moderate on the Absted soil. If the cover is destroyed, the hazard of wind erosion is high on the Lohsman and Absted soils.

Soils of this complex are used for range and wildlife habitat. (Capability unit VIe–71, dryland. Lohsman and Absted soils in Loamy range site, 10 to 14 inch precipitation zone, Orella soil in Dense Clay range site, 10 to 14 inch precipitation zone)

Lymanson Series

The Lymanson series consists of moderately steep or steep, well-drained soils. These soils formed in residuum weathered from shale on ridges in the mountains. Slopes range from 10 to 30 percent. Elevations range from 8,000 to 9,500 feet. The average annual precipitation is 18 to 19 inches, the average annual soil temperature is about 40° F., and average summer soil temperature is about 53°

F. The frost-free season is 65 to 70 days, although frost can occur during any month. The vegetation is Idaho fescue and other mountain grasses and sedges.

In a representative profile the surface layer is grayish-brown, mildly alkaline loam about 5 inches thick. The upper part of the subsoil is brown, mildly alkaline loam about 5 inches thick, and the lower part is brown, moderately alkaline loam about 3 inches thick. The substratum is light olive-brown, moderately alkaline loam, about 17 inches thick, that is underlain by soft sandstone at a depth of about 30 inches.

Permeability is moderate, and the available water capacity is moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Lymanson loam, in an area of Turk-Lymanson-Jenkinson association, in the NE¼ NE¼ sec. 28, T. 42 N., R. 85 W.

A1—0 to 5 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; strong, fine, granular structure; soft, very friable; mildly alkaline; clear, smooth boundary.

B2t—5 to 10 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; hard, very friable; common, thin, waxlike patches on ped faces; thin waxlike coatings in root channels; mildly alkaline; clear, wavy boundary.

B3ca—10 to 13 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak, medium, subangular blocky structure; hard, very friable; few, thin, glossy patches on ped faces; weak secondary calcium carbonate occurring as concretions; strong effervescence; moderately alkaline; gradual, wavy boundary.

C1ca—13 to 30 inches, light olive-brown (2.5Y 5/3) loam, olive brown (2.5Y 4/3) moist; massive; hard, very friable; secondary calcium carbonate occurring as concretions and in thin seams and streaks; strong effervescence; moderately alkaline; gradual, wavy boundary.

C2—30 inches, soft, calcareous sandstone.

These soils generally are noncalcareous in the A horizon and the upper part of the B2t horizon, but in places they are calcareous in the upper 8 inches. Depth to bedrock ranges from 20 to 40 inches, and thickness of the solum ranges from 8 to 15 inches. Content of coarse fragments ranges from 0 to 20 percent.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. In most places the primary structure is granular or crumb, but in some places it is subangular blocky. This horizon is soft or slightly hard when dry. The A1 and B2t horizons are mildly alkaline or moderately alkaline.

The B2t horizon ranges from 2.5Y to 7.5YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. In most places the primary structure is prismatic, but in some places it is subangular blocky. This horizon generally is loam or clay loam, but content of clay ranges from about 18 to 35 percent.

The Cca horizon ranges from 5Y to 10YR in hue. It is moderately alkaline or strongly alkaline. The calcium carbonate equivalent ranges from about 4 to 12 percent.

Lymanson soils are mapped in an association with Jenkinson and Turk soils.

Mathers Series

The Mathers series consists of moderately steep or steep, well-drained soils. These soils formed in residuum weathered from granite rock. They are in timbered areas in the mountains. Slopes range from 10 to 30 percent. Elevations range from 8,000 to 9,500 feet. The average annual precipitation is 18 to 19 inches, the average annual soil temperature is about 39° F., and the average summer soil temperature is about 56° F. The frost-free season is 60 to 65 days, although frost can occur during any month. The vegetation is Douglas-fir and lodgepole pine.

In a representative profile about 3 inches of forest litter covers a surface layer of brown, medium acid sandy loam about 2 inches thick. The subsurface layer is pink, medium acid gravelly sandy loam about 5 inches thick. The upper part of the subsoil is mixed pink and brown, medium acid gravelly sandy clay loam about 5 inches thick; the middle is light-brown, slightly acid gravelly sandy clay loam about 15 inches thick; and the lower part is light yellowish-brown, slightly acid gravelly sandy loam about 6 inches thick. The substratum is pale-brown, neutral gravelly loamy sand that reaches to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is moderate. The effective rooting depth is 60 inches or more.

These soils are used for woodland and wildlife habitat.

Representative profile of Mathers sandy loam, in an area of Pineguest-Mathers association, a short distance north of the survey area boundary, in the SW¼SW¼ sec. 24, T. 47 N., R. 85 W.

O1—3 inches to 1 inch, undecomposed organic material that consists mainly of needles, bark, and twigs.

O2—1 inch to 0, partly decomposed organic material that consists mainly of needles, bark, and twigs.

A1—0 to 2 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; strong, fine, crumb structure; soft, very friable; few charcoal fragments; medium acid; clear, smooth boundary.

A2—2 to 7 inches, pink (7.5YR 7/3) gravelly sandy loam, brown (7.5YR 5/3) moist; moderate, medium, platy structure parting to moderate, fine, crumb and granular; soft, very friable; few charcoal fragments; 20 percent gravel, most of which is fine and very fine, angular, granite fragments; medium acid; gradual, wavy boundary.

B&A 7 to 12 inches, mixed colors including pink (7.5YR 7/3) and brown (7.5YR 5/4) gravelly sandy clay loam, brown (7.5YR 5/3) and dark brown (7.5YR 4/4) moist; weak, medium, subangular blocky structure; extremely hard, very friable; horizon consists of nodules and seams of clayey material from the B2t horizon embedded in a matrix of lighter colored material from the A2 horizon; a few glossy patches on the more clayey parts of the aggregates; 20 percent gravel, most of which is fine and very fine, angular, granite fragments; medium acid; gradual, wavy boundary.

B2t—12 to 27 inches, light-brown (7.5YR 6/4) gravelly sandy clay loam, brown (7.5YR 5/4) moist; moderate, medium, subangular blocky structure; extremely hard, very friable; thin, nearly continuous, waxlike coatings on ped faces, on inside of root channels, and on sand grains and as bridgings between sand grains; 20 percent gravel, most of which is fine and very fine, angular, granite fragments; slightly acid; gradual, wavy boundary.

B3—27 to 33 inches, light yellowish-brown (10YR 6/4) gravelly sandy loam, yellowish brown (10YR 5/4) moist; weak, medium, subangular blocky structure; extremely hard, very friable; few, thin, glossy patches on ped faces; 25 percent gravel, most of which is fine and very fine, angular, granite fragments; slightly acid; diffuse, wavy boundary.

C—33 to 60 inches, pale-brown (10YR 6/3) gravelly loamy sand, brown (10YR 5/3) moist; single grained; hard, loose; 40 to 50 percent gravel, most of which is fine and very fine, angular, granite fragments; neutral.

Depth to gravelly loamy sand and thickness of the solum range from 20 to 40 inches. Content of coarse fragments ranges from 15 to 35 percent in the solum. Most of the fragments are fine and very fine, angular, granite pebbles.

The A2 horizon ranges from 10YR to 7.5YR in hue, is 6 or 7 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It is medium acid or slightly acid. In most places the primary structure is platy, but in some places it is granular. This horizon is soft or slightly hard when dry.

The B2t horizon ranges from 10YR to 5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 3 or 4 in chroma when dry or moist. It ranges from medium acid to neutral.

The C horizon ranges from 10YR to 5YR in hue.

Mathers soils are mapped in an association with Pineguest soils.

Maysdorf Series

The Maysdorf series consists of nearly level to moderately steep, well-drained soils. These soils formed in reddish-colored and brownish-colored alluvium on foot slopes and hillsides. Slopes range from 0 to 15 percent. Elevations range from 4,500 to 5,500 feet. The average annual precipitation is 12 to 14 inches, the average annual soil temperature is about 52° F., and the frost-free season is about 105 days. The vegetation is western wheatgrass, needle-and-thread, and blue grama.

In a representative profile the surface layer is light brownish-gray, neutral sandy loam about 4 inches thick. The upper part of the subsoil is brown or reddish-brown, neutral or mildly alkaline sandy loam or sandy clay loam about 28 inches thick, and the lower part is brown, moderately alkaline fine sandy loam about 8 inches thick. The substratum is pale-brown, moderately alkaline fine sandy loam that reaches to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is moderate to high. The effective rooting depth is 50 to 60 inches or more.

These soils are used for range, dryfarming, and wildlife habitat.

Representative profile of Maysdorf sandy loam, in an area of Maysdorf-Garrett association, about 2 miles east of the Urrity Ranch headquarters, in the unsectionized area of Johnson County east of Powder River.

A1—0 to 4 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; strong, fine, granular structure; soft, very friable; neutral; clear, smooth boundary.

B1—4 to 10 inches, brown (7.5YR 5/2) sandy loam, dark brown (7.5YR 4/3) moist; moderate, very coarse, prismatic structure parting to moderate, coarse, subangular blocky; slightly hard, very friable; some clay bridgings between sand grains; neutral; clear, smooth boundary.

B21t—10 to 26 inches, reddish-brown (5YR 5/3) sandy clay loam, reddish brown (5YR 4/3) moist; moderate, coarse and very coarse, prismatic structure parting to moderate, coarse, angular and subangular blocky; very hard, very friable; thin patchy clay films on horizontal and vertical faces of soil aggregates; clay coatings on sand grains and clay bridgings between sand grains; mildly alkaline; gradual, smooth boundary.

IIB22t—26 to 32 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) moist; moderate, coarse and very coarse, prismatic structure parting to moderate, coarse, subangular blocky; hard, very friable; thin patchy clay films on horizontal and vertical faces of soil aggregates; clay coatings on sand grains and clay bridgings between sand grains; mildly alkaline; gradual, smooth boundary.

IIB3ca—32 to 40 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak, coarse, subangular blocky structure; slightly hard, very friable; weak clay coatings on sand grains and clay bridgings between sand grains; this is a weak ca horizon that has visible calcium carbonate occurring as concretions and in thin seams and streaks; strong effervescence; moderately alkaline; gradual, wavy boundary.

IICca—40 to 60 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; massive to single grained; slightly hard, very friable; this is a weak ca horizon that has some visible calcium carbonate occurring as concretions; strong effervescence; moderately alkaline.

Depth to bedrock is 50 inches or more, depth to carbonates ranges from 12 to 40 inches, and thickness of the solum ranges from 20 to 50 inches. Content of coarse fragments typically is less than 5 percent.

The A1 horizon ranges from 10YR to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 2 or 3 in chroma when dry or moist. The A1 horizon is not more than 8 inches thick. The A1 and B21t horizons are neutral or mildly alkaline.

The B2t horizon ranges from 7.5YR in hue, ranges from 4 to 6 in value when dry and is 4 or 5 when moist, and ranges from 3 to 5 in chroma when dry and is 3 or 4 when moist.

The IIB22t, IIB3ca, and IICca horizons range from 10YR to 2.5Y in hue. The IIB22t horizon ranges from mildly alkaline to moderately alkaline. The IIB3ca and IICca horizons range from moderately alkaline to strongly alkaline.

Maysdorf sandy loam, 0 to 6 percent slopes (MdB).—This soil is on foot slopes and hillsides. It has a profile similar to the one described as representative of the series, except that the surface layer is about 8 inches thick.

Included with this soil in mapping are areas of Fort Collins and Stoneham soils.

Runoff is slow to medium, and the hazard of water erosion is slight to moderate. If the soil is left bare, the hazard of wind erosion is high.

This soil is used for dryland spring wheat and range. (Capability unit IVe-5, dryland; Loamy range site, 10 to 14 inch precipitation zone)

Maysdorf sandy loam, 6 to 10 percent slopes (MdC).—This soil is on alluvial hillsides and foot slopes. It has a profile similar to the one described as representative of the series, except that the surface layer is 6 to 8 inches thick.

Included with this soil in mapping are areas of Briggsdale and Cushman soils.

Runoff is medium, and the hazard of water erosion is moderate. If the soil is left bare, the hazards of wind and water erosion are high.

This soil is used for dryland spring wheat and range. (Capability unit VIe-5, dryland; Loamy range site, 10 to 14 inch precipitation zone)

Maysdorf association (MF).—This association is mainly Maysdorf sandy loam, 6 to 15 percent slopes. Other soils in this association are some reddish-colored soils similar to Briggsdale soils and some reddish-colored, very strongly alkaline soils similar to Absted soils. These other soils vary considerably in their extent within the association. The soils in this association occupy rolling or hilly uplands, hillsides, and alluvial fans. The soils that are similar to Briggsdale soils are on uplands, the Maysdorf

soil is on hillsides, and the soils that are similar to Absted soils are on alluvial fans.

Included with these soils in mapping are areas of Shingle soils, some reddish-colored soils similar to Shingle soils, some Cushman soils, and some reddish-colored soils similar to Kim soils.

Runoff is medium to rapid, and the hazard of water erosion is moderate to high. If the cover is destroyed, the hazard of wind erosion is high.

Soils of this association are used for range and wildlife habitat. (Capability unit VIe-5, dryland; Loamy range site, 10 to 14 inch precipitation zone)

Maysdorf-Garrett association (MG).—This association is about 40 percent Maysdorf sandy loam, 6 to 15 percent slopes, and about 30 percent Garrett sandy loam, 6 to 15 percent slopes. The Maysdorf and Garrett soils have the profiles described as representative of the Maysdorf and Garrett series. They are on hillsides and alluvial foot slopes. They are rolling to hilly.

Included with these soils in mapping are areas of reddish-colored soils similar to Embry soils that make up about 15 percent of the acreage and areas of Southfork soils that make up about 5 percent.

Runoff is medium to rapid, and the hazard of water erosion is moderate to high. If the cover is destroyed, the hazard of wind erosion is high.

Soils of this association are used for range and wildlife habitat. (Capability unit VIe-5, dryland; Loamy range site, 10 to 14 inch precipitation zone)

Maysdorf-Pugsley association (MP).—This association is about 35 percent Maysdorf sandy loam, 6 to 15 percent slopes; about 30 percent Pugsley sandy loam, 6 to 15 percent slopes; and about 20 percent Garrett sandy loam, 6 to 15 percent slopes. These soils occupy uplands and foot slopes. The Pugsley soil is on uplands, and the Maysdorf and Garrett soils are on foot slopes.

Included with these soils in mapping are areas of Cushman soils that make up about 10 percent of the acreage and areas of Shingle soils that make up about 5 percent.

Runoff is medium to rapid, and the hazard of water erosion is moderate to high. If the cover is destroyed, the hazard of wind erosion is high.

Soils of this association are used for range and wildlife habitat. (Capability unit VIe-5, dryland; Loamy range site, 10 to 14 inch precipitation zone)

Maysdorf-Schooner association (MR).—This association is about 40 percent Maysdorf sandy loam, 6 to 15 percent slopes, and about 30 percent Schooner loamy sand, 10 to 30 percent slopes. The Schooner soil has the profile described as representative of the Schooner series. These soils occupy upland ridges and hillsides. The Schooner soil is on ridges, and the Maysdorf soil is on hillsides.

Included with these soils in mapping are areas of Southfork soils that make up about 15 percent of the acreage, areas of reddish-colored soils similar to Embry soils that make up about 10 percent, and areas of Pugsley soils that make up about 5 percent.

Runoff is medium to rapid, and the hazard of water erosion is moderate to high. If the cover is destroyed, the hazard of wind erosion is high.

Soils of this association are used for range and wildlife habitat. (Maysdorf soil in capability unit VIe-5, dryland, and Loamy range site, 10 to 14 inch precipitation zone. Schooner soil in capability unit VIIe-14, dryland, and Shallow Sandy range site, 10 to 14 inch precipitation zone)

Moret Series

The Moret series consists of moderately steep or steep, well-drained soils. These soils formed in residuum weathered from noncalcareous shale on ridges and hillsides. Slopes range from 10 to 30 percent. Elevations range from 5,000 to 6,000 feet. The average annual precipitation is 12 to 13 inches, the average annual soil temperature is about 51° F., and the frost-free season is 95 to 100 days. The vegetation is western wheatgrass, bluebunch wheatgrass, and big sagebrush.

In a representative profile these soils are light brownish-gray, neutral clay loam about 15 inches thick that is underlain by hard slaty shale at a depth of about 15 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is 10 to 20 inches.

These soils are used for range annd wildlife habitat.

Representative profile of Moret clay loam, in an area of Moret-Kirtley association, in the NE¼NE¼ sec. 23, T. 42 N., R. 83 W.

A1—0 to 6 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; moderate, fine, granular structure; soft, very friable; 5 percent hard shale fragments; neutral; gradual, smooth boundary.

C—6 to 15 inches, light brownish-gray (2.5Y 6/2) clay loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, very friable; 10 percent hard shale chips; neutral; abrupt, wavy boundary.

R—15 inches, hard, noncalcareous, slaty shale.

Depth to bedrock ranges from 10 to 20 inches. Content of coarse fragments ranges from 0 to 35 percent but typically is less than 10 percent. The soil is loam or clay loam throughout the profile.

The A1 horizon ranges from 5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 1 to 3 in chroma when dry or moist. In most places the primary structure is granular, but in some places it is subangular blocky. This horizon is soft or slightly hard when dry. The A and C horizons are neutral or mildly alkaline.

The C horizon ranges from 5Y to 10YR in hue.

Moret-Kirtley association (MU).—This association is about 40 percent Moret clay loam, 10 to 30 percent slopes, and about 35 percent Kirtley loam, 6 to 15 percent slopes. The Moret soil has the profile described as representative of the Moret series. These soils occupy uplands. The Moret soil is on long, rounded ridges, and the Kirtley soil is on hillsides. These soils are rolling to hilly.

Included with these soils in mapping are areas of Shirk soils that make up about 15 percent of the acreage and areas of soils that are similar to this Moret soil that make up about 10 percent. The soils that are similar to Moret soils differ from them in that they are less than 10 inches deep to bedrock.

Runoff is rapid on the Moret soil and medium to rapid on the Kirtley soil. The hazard of erosion is high on the Moret soil and moderate to high on the Kirtley soil.

Soils of this association are used for range and as wildlife habitat. (Moret soil in capability unit VIIe-14, dryland, and Shallow Clayey range site, 10 to 14 inch precipitation zone. Kirtley soil in capability unit VIe-2,

dryland, and Loamy range site, 10 to 14 inch precipitation zone)

Moret-Rencalson complex, hilly (MSD).—This complex is about 50 percent Moret clay loam, 10 to 30 percent slopes, and about 30 percent Rencalson loam, 10 to 15 percent slopes. The Rencalson soil has the profile described as representative of Rencalson series. These soils occupy uplands. The Moret soil is on ridges and hillsides, and the Rencalson soil is on the lower hillsides.

Included with these soils in mapping are areas of Keyner soils that make up about 10 percent of the acreage. Also included are areas of Shale outcrop that make up about 5 percent and areas of soils similar to the Rencalson soil that make up about 5 percent. These soils differ from Rencalson soils in that they are 10 to 20 inches deep to bedrock.

Runoff is rapid, and the hazard of erosion is high.

Soils of this complex are used for range and wildlife habitat. (Capability unit VIIe-14, dryland. Moret soil in Shallow Clayey range site, 10 to 14 inch precipitation zone, and Rencalson soil in Clayey range site, 10 to 14 inch precipitation zone)

Moret-Rock land complex, hilly (MTD).—This complex is about 50 percent Moret clay loam, 10 to 30 percent slopes, and about 25 percent Rock land. These soils occupy uplands. The Moret soil is on upland ridges and hillsides, and the Rock land is along the ridge crests and in drainageways.

Included with these soils in mapping are areas of Shirk soils that make up about 15 percent of the acreage and very shallow soils that make up about 10 percent.

Runoff is rapid, and the hazard of erosion is high.

Soils of this complex are used for range and wildlife habitat. (Capability unit VIIe-14, dryland. Moret soil in Shallow Clayey range site, 10 to 14 inch precipitation zone, and Rock land not in a range site)

Moret-Shirk association (MV).—This association is about 40 percent Moret clay loam, 10 to 30 percent slopes, and about 30 percent Shirk clay loam, 10 to 20 percent slopes. The Moret soil has the profile described as representative of the Moret series. These soils occupy uplands. The landscape generally is one of long, fairly narrow areas that dip eastward. The Moret soil is on ridges and the upper hillsides. Generally, the Shirk soil is on uniformly sloping upland hillsides.

Included with these soils in mapping are areas of Rhoame soils that make up about 15 percent of the acreage and very shallow soils similar to the Moret soil that make up about 10 percent. The very shallow soils differ from Moret soils in that bedrock is at a depth of less than 10 inches. Also included are areas of Kirtley soils that make up about 5 percent of the acreage.

Runoff is rapid, and the hazard of erosion is high.

Soils of this association are used for range and wildlife habitat. (Moret soil in capability unit VIIe-14, dryland; Shirk soil in capability unit VIe-2, dryland. Both soils in Shallow Clayey range site, 10 to 14 inch precipitation zone)

Nathrop Series

The Nathrop series consists of moderately steep or steep, well-drained soils. These soils formed in residuum weathered from limestone on ridges and hillsides in the mountains. Slopes range from 10 to 30 percent. Elevations range from 7,500 to 9,000 feet. The average annual precipitation is 15 to 19 inches, and the average annual soil temperature is about 42° F. The frost-free season is 60 to 65 days, although frost can occur during any month. The vegetation is Idaho fescue and big bluegrass.

In a representative profile the surface layer is grayish-brown, mildly alkaline stony loam about 4 inches thick. The subsoil is grayish-brown or brown, mildly alkaline loam or stony clay loam about 9 inches thick. The substratum is pale-brown or very pale brown, moderately alkaline or strongly alkaline stony clay loam, about 15 inches thick, that is underlain by fractured limestone at a depth of about 28 inches.

Permeability is moderate, and the available water capacity is low to moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Nathrop stony loam, in an area of Nathrop-Starley association, in the NE¼NW¼ sec. 27, T. 45 N., R. 84 W.

A1—0 to 4 inches, grayish-brown (10YR 5/2) stony loam, very dark brown (10YR 2/2) moist; moderate, fine, crumb structure; soft, very friable; many 1- to 3-inch limestone fragments; many roots; mildly alkaline; clear, smooth boundary.

B21t—4 to 7 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak, fine, angular blocky structure; thin patchy clay films on ped surfaces; slightly hard, friable, slightly sticky and slightly plastic; 15 percent 1- to 3-inch limestone fragments; many roots; mildly alkaline; clear, smooth boundary.

B22t—7 to 13 inches, brown (10YR 5/3) stony clay loam, dark brown (10YR 4/3) moist; moderate, fine, subangular blocky structure; thick patchy clay films; hard, firm, sticky and plastic; 15 percent of mass is 1- to 3-inch limestone fragments; mildly alkaline; gradual, wavy boundary.

C1ca—13 to 20 inches, pale-brown (10YR 6/3) stony clay loam, brown (10YR 5/3) moist; structureless; slightly hard, firm, slightly sticky and slightly plastic; more than 35 percent of mass is 1- to 4-inch limestone fragments; few fine, distinct mottles of calcium carbonate; strong effervescence; moderately alkaline; gradual, wavy boundary.

C2ca—20 to 28 inches, very pale brown (10YR 7/4) stony clay loam, light yellowish brown (10YR 6/4) moist; structureless; soft, friable, slightly sticky and slightly plastic; more than 35 percent of mass is 1- to 4-inch limestone fragments; many, fine, distinct threads and specks of calcium carbonate; violent effervescence; strongly alkaline; clear, smooth boundary.

R—28 inches, hard fractured limestone.

Depth to bedrock ranges from 20 to 40 inches, and depth to carbonates ranges from 8 to 15 inches.

The A1 horizon ranges from 10YR to 7.5YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. The A and B horizons are neutral or mildly alkaline.

The B21t horizon is 10YR or 7.5YR in hue, 4 or 5 in value when dry and 2 or 3 when moist, and 2 or 3 in chroma when dry or moist. It is stony loam or clay loam. The B22t horizon ranges from 10YR to 7.5YR in hue, ranges from 4 to 6 in value when dry and is 3 or 4 when moist, and is 3 or 4 in chroma when dry or moist.

The C horizon ranges from 2.5Y to 7.5YR in hue. It is moderately alkaline or strongly alkaline. Content of limestone fragments ranges from 35 to 50 percent or more.

Nathrop-Passcreek association (NP).—This association is about 50 percent Nathrop stony loam, 10 to 30 percent

slopes, and about 30 percent Passcreek loam, 6 to 20 percent slopes. These soils occupy hillsides in the mountains. The Nathrop soil is on the upper parts of hillsides, and the Passcreek soil is on the lower hillsides.

Included with these soils in mapping are areas of Starley soils that make up about 15 percent of the acreage and areas of Woosley soils that make up about 5 percent.

Runoff is rapid on the Nathrop soil and medium to rapid on the Passcreek soil. The hazard of erosion is high on the Nathrop soil and moderate to high on the Passcreek soil.

Soils of this association are used for range and wildlife habitat. (Nathrop soil in capability unit VIs–9, dryland, and Coarse Upland range site, 15 to 19 inch precipitation zone. Passcreek soil in capability unit VIe–2, dryland, and Loamy range site, 15 to 19 inch precipitation zone)

Nathrop-Starley association (NS).—This association is about 40 percent Nathrop stony loam, 10 to 30 percent slopes, and about 30 percent Starley gravelly loam, 10 to 40 percent slopes (fig. 8). The Nathrop soil has the profile described as representative of the Nathrop series. These soils occupy ridges and hillsides in the mountains. The Nathrop soil is on the lower hillsides, and the Starley soil is on the upper hillsides and on ridge crests.

Included with these soils in mapping are areas of Woosley soils that make up about 15 percent of the acreage, areas of Leavitt soils that make up about 10 percent, and areas of Rock outcrop that make up about 5 percent.

Runoff is rapid, and the hazard of erosion is high.

Soils of this association are used for range and wildlife habitat. (Nathrop soil in capability unit VIs–9, dryland, and Coarse Upland range site, 15 to 19 inch precipitation zone. Starley soil in capability unit VIIe–14, dryland, and Shallow Loamy range site, 15 to 19 inch precipitation zone)

Nathrop-Woosley association (NW).—This association is about 40 percent Nathrop stony loam, 10 to 30 percent slopes, and about 35 percent Woosley loam, 6 to 20 percent slopes. The Woosley soil has the profile described as representative of the Woosley series. These soils occupy hillsides in the mountains. The Nathrop soil is on the upper hillsides, below the ridgetops. The Woosley soil is on the lower hillsides, below the Nathrop soils.

Included with these soils in mapping are areas of Starley soils that make up about 15 percent of the acreage. Also included are areas of Decross soils that make up about 5 percent and areas of Rock land that make up about 5 percent.

Runoff is rapid on the Nathrop soil and medium to rapid on the Woosley soil. The hazard of water erosion is high on the Nathrop soil and moderate to high on the Woosley soil.

Soils of this association are used for range and wildlife habitat. (Nathrop soil in capability unit VIs–9, dry-

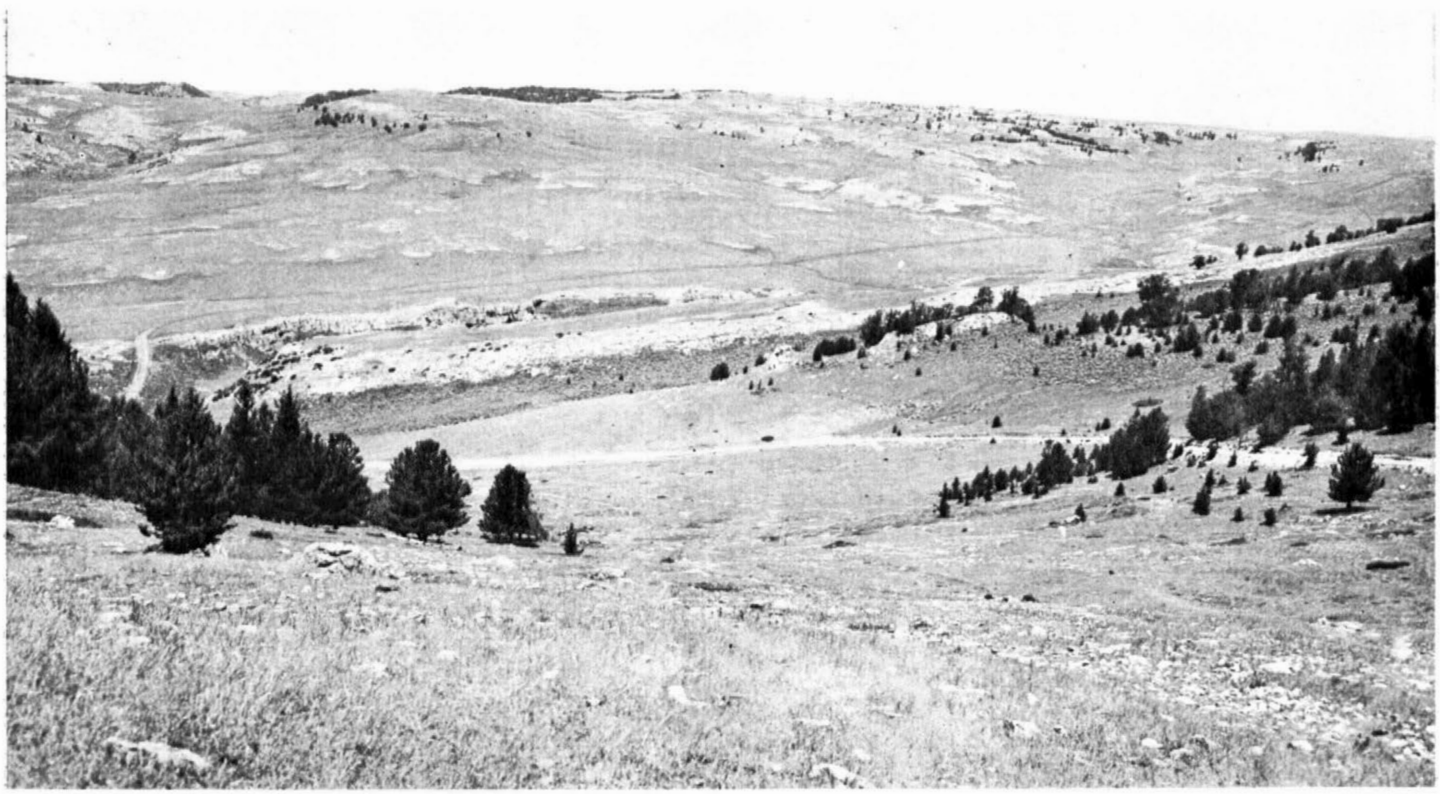

Figure 8.—**Area of Nathrop-Starley association along Arch Creek.**

land, and Coarse Upland range site, 15 to 19 inch precipitation zone. Woosley soil in capability unit VIe-2, dryland, and Loamy range site, 15 to 19 inch precipitation zone)

Orella Series

The Orella series consists of rolling or hilly, well drained or moderately well drained soils. These soils formed in residuum weathered from alkaline shale on uplands. Slopes range from 6 to 20 percent. Elevations range from 4,500 to 5,000 feet. The average annual precipitation is 10 to 11 inches, the average annual soil temperature is about 51° F., and the frost-free season is 100 to 110 days. These soils are nearly barren, except for isolated clumps of birdfoot sagebrush.

In a representative profile the surface layer is light-gray, mildly alkaline silty clay about 1 inch thick. The underlying layer is light olive-gray, very strongly alkaline silty clay, about 13 inches thick, that is underlain by soft, calcareous, clay shale at a depth of about 14 inches.

Permeability is very slow, and the available water capacity is low. The effective rooting depth is 10 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Orella silty clay, in an area of Lohsman-Orella complex, hilly, in the SE¼SW¼ sec. 17, T. 43 N., R. 78 W.

A1—0 to 1 inch, light-gray (5Y 7/2) silty clay, olive (5Y 5/3) moist; porous crust; slightly hard, firm, sticky and plastic; mildly alkaline; gradual, wavy boundary.

C1—1 to 14 inches, light olive-gray (5Y 6/2) silty clay, olive (5Y 5/3) moist; massive; slightly hard, very firm, very sticky and plastic; slight effervescence; very strongly alkaline; gradual, wavy boundary.

C2—14 inches, soft, calcareous, clay shale.

These soils generally are calcareous to the surface, but in places they are noncalcareous in the uppermost 1 or 2 inches. Depth to bedrock ranges from 10 to 20 inches but typically is 12 to 14 inches. Texture of the profile is silty clay or clay, and the content of clay is 40 to 60 percent. Content of coarse fragments typically is less than 5 percent.

The A1 horizon ranges from 5Y to 2.5Y in hue, ranges from 5 to 7 in value when dry and is 4 or 5 when moist, and is 2 or 3 in chroma when dry or moist.

The C horizon ranges from 5Y to 10YR in hue, ranges from 5 to 7 in value when dry and is 4 or 5 when moist, and is 2 or 3 in chroma when dry or moist.

Orella soils are mapped in a complex with Lohsman soils and occur as inclusions in many mapping units.

Otero Series

The Otero series consists of sloping or moderately steep, well-drained soils. These soils formed in alluvium derived from sandstone. They are on alluvial fans. Slopes range from 6 to 20 percent. Elevations range from 4,500 to 5,200 feet. The average annual precipitation is 10 to 12 inches, the average annual soil temperature is about 53° F., and the frost-free season is 105 to 110 days. The vegetation is western wheatgrass, silver sagebrush, and blue grama.

In a representative profile the surface layer is dark-brown, neutral sandy loam about 4 inches thick. The underlying layer is brown or grayish-brown, moderately alkaline sandy loam that reaches to a depth of about 42 inches. This layer is underlain by grayish-brown, moderately alkaline very fine sandy loam that reaches to a depth of 60 inches or more.

Permeability is moderately rapid, and the available water capacity is moderate. The effective rooting depth is 60 inches or more.

These soils are used for range and wildlife habitat.

Representative profile of Otero sandy loam in an area of the Otero-Kim association in the NE¼NE¼ sec. 37, T. 45 N., R. 82 W.

A1—0 to 4 inches, dark-brown (10YR 4/3) sandy loam, dark brown (10YR 3/3) moist; weak, fine, crumb structure; soft, very friable; many roots; neutral; clear, smooth boundary.

C1—4 to 30 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; structureless; loose; few roots to depth of 16 inches, very few roots below this to a depth of 30 inches; strong effervescence; moderately alkaline; clear, smooth boundary.

C2—30 to 42 inches, grayish-brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; structureless; loose; strong effervescence; moderately alkaline; gradual, wavy boundary.

C3—42 to 60 inches, grayish-brown (2.5Y 5/2) very fine sandy loam, dark grayish brown (2.5Y 4/2) moist; structureless; soft, friable, slightly sticky; strong effervescence; moderately alkaline.

These soils generally are calcareous to the surface, but in places they are noncalcareous in the uppermost 6 inches. Content of coarse fragments typically is less than 5 percent.

The A1 horizon ranges from 2.5Y to 7.5YR in hue, is 4 or 5 in value when dry and 3 or 4 when moist, and is 2 or 3 in chroma when dry or moist. The A1 horizon ranges from 2 to 4 inches in thickness. It ranges from neutral to moderately alkaline.

The C horizon ranges from 2.5Y to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 2 or 3 in chroma when dry or moist. It is moderately alkaline or strongly alkaline.

Otero-Kim association (OK).—This association is about 30 percent Otero sandy loam, 6 to 20 percent slopes; about 25 percent Kim loam, 6 to 20 percent slopes; and about 20 percent Glenberg sandy loam, 0 to 3 percent slopes. The Otero soil in this association has the profile described as representative of the Otero series. These soils occupy alluvial fans and drainageways at the base of uplands. The Otero and Kim soils are on alluvial fans that lead into drainageways, and the Glenberg soil is on the bottoms of drainageways.

Included with these soils in mapping are areas of Bankard soils that make up about 15 percent of the acreage. Also included are gravel bars that make up about 5 percent and intermittent stream channels that make up about 5 percent.

Runoff is medium to rapid on the Otero and Kim soils and slow on the Glenberg soil. The hazard of erosion is moderate to high on the Otero and Kim soils and slight on the Glenberg soil. If the cover is destroyed, the hazard of wind erosion is high on the Otero and Glenberg soils.

Soils of this association are used for range and wildlife habitat and, in some areas, as a source of sand and gravel. (Otero soil in capability unit VIe-5, dryland, and Sandy range site, 10 to 14 inch precipitation zone; Kim soil in capability unit VIe-2, dryland, and Loamy range site, 10 to 14 inch precipitation zone; Glenberg

soil in capability unit IVe–5, dryland, and Overflow range site, 10 to 14 inch precipitation zone)

Passcreek Series

The Passcreek series consists of sloping or moderately steep, well-drained soils. These soils formed in residuum weathered from sandstone on hillsides in the mountains. Slopes range from 6 to 20 percent. Elevations range from 7,600 to 9,000 feet. The average annual precipitation is 15 to 18 inches, and the average annual soil temperature is about 42° F. The frost-free season is 65 to 70 days, although frost can occur during any month. The vegetation is mainly Idaho fescue and scattered ponderosa pine.

In a representative profile the surface layer is dark grayish-brown, neutral loam about 4 inches thick. The subsoil is brown, neutral to mildly alkaline loam or clay loam about 10 inches thick. The substratum is light brownish-gray, moderately alkaline channery loam about 9 inches thick that is underlain by hard sandstone bedrock at a depth of about 23 inches.

Permeability is moderate, and the available water capacity is low to moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Passcreek loam, in an area of Passcreek-Sublette-Slipman association, in the SW¼ SW¼ sec. 30, T. 45 N., R. 83 W.

A1—0 to 4 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; strong, very fine, granular and crumb structure; soft, very friable; 5 percent sandstone gravel; neutral; gradual, smooth boundary.

B2t—4 to 11 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate, medium, subangular blocky structure; hard, very friable; many, thin, waxlike patches and seams on ped faces; waxlike coatings in inside of root channels; 5 percent sandstone gravel; neutral; clear, smooth boundary.

B3ca—11 to 14 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) moist; weak, medium, subangular blocky structure; hard, friable; few, thin, glossy patches on ped faces; 5 percent sandstone gravel; some visible secondary calcium carbonate occurring as coatings on gravel fragments; strong effervescence; mildly alkaline; clear, smooth boundary.

Cca—14 to 23 inches, light brownish-gray (10YR 6/2) channery loam, dark grayish brown (10YR 4/2) moist; structureless; slightly hard, very friable; 20 percent sandstone channery fragments; visible secondary calcium carbonate occurring as concretions, in thin seams and streaks, and as coatings on sandstone fragments; strong effervescence; moderately alkaline; clear, irregular boundary.

R—23 inches, hard sandstone bedrock.

Depth to bedrock ranges from 20 to 40 inches, depth to calcareous material ranges from 6 to 14 inches, and thickness of the solum ranges from 12 to 20 inches. Content of coarse fragments ranges from 0 to 15 percent in most of the solum, but it may be more than 15 percent in the Cca horizon.

The A1 horizon ranges from 10YR to 2.5Y in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. This horizon is soft or slightly hard when dry. The A and B2t horizons are neutral or mildly alkaline.

The B2t horizon ranges from 10YR to 2.5Y in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 3 or 4 in chroma when dry and 2 or 3 when moist. In most places the primary structure is subangular blocky, but in some places it is prismatic. It is clay loam or loam, and the content of clay ranges from 18 to 35 percent.

The B3ca and Cca horizons range from 10YR to 2.5Y in hue. The calcium carbonate equivalent ranges from approximately 6 to 12 percent.

Passcreek-Sublette-Slipman association (PA).—This association is about 30 percent Passcreek loam, 6 to 20 percent slopes; about 20 percent Sublette sandy loam, 6 to 20 percent slopes; about 15 percent Slipman sandy loam, 10 to 20 percent slopes; and about 15 percent Sunup channery clay loam, 15 to 40 percent slopes. These soils have the profiles described as representative of the Passcreek, Sublette, and Slipman series. They are on the flanks of mountains, and they occupy stony ridges, narrow valleys, and hillsides. Elevations range from 6,000 to 8,000 feet. The Passcreek and Slipman soils are on hillsides, the Sublette soil is on alluvial foot slopes, and the Sunup soil is on ridge crests and the upper hillsides.

Included with these soils in mapping are some areas of soils that have cool summer temperatures and extend down the slope of the mountain into areas that have an average annual temperature of more than 47° F. Also included are areas of Carnero soils that make up about 10 percent of the acreage. Other inclusions are areas of Leavitt soils that make up about 5 percent and areas of Rock land that make up about 5 percent.

Runoff is medium to rapid on the Passcreek and Sublette soils and rapid on the Slipman and Sunup soils. The hazard of erosion is moderate to high on the Passcreek and Sublette soils and high on the Slipman and Sunup soils.

Soils of this association are used for range, woodland, and wildlife habitat. The dominant tree species on the Slipman soil is ponderosa pine. Woodland production includes sawtimber, posts, and poles. Access in some areas is limited. The Slipman part of this association is in woodland group 3. (Passcreek soil in capability unit VIe–2, dryland, and Loamy range site, 15 to 19 inch precipitation zone. Sublette and Slipman soils in capability unit VIe–5, dryland. Sublette soil in Sandy range site, 15 to 19 inch precipitation zone; Slipman soil not in a range site. Sunup soil in capability unit VIIe–14, dryland, and Shallow Clayey range site, 10 to 14 inch precipitation zone)

Petrie Series

The Petrie series consists of nearly level to sloping, well-drained soils. These soils formed in alluvium on alluvial fans. Slopes range from 0 to 10 percent. Elevations range from 4,500 to 5,200 feet. The average annual precipitation is 10 to 14 inches, the average annual soil temperature is about 53° F., and the frost-free season is 105 to 110 days. The vegetation is western wheatgrass and greasewood.

In a representative profile the surface layer is grayish-brown, strongly alkaline silty clay about 3 inches thick. The underlying layer is olive-gray or light brownish-gray, strongly alkaline or very strongly alkaline clay or silty clay that reaches to a depth of 60 inches or more.

Permeability is very slow, and the available water capacity is low to moderate. The effective rooting depth is 60 inches or more.

These soils are used for range, for irrigated pasture, and as wildlife habitat.

Representative profile of Petrie silty clay, in an area of Petrie-Bone complex, in the SE¼NE¼ sec. 21, T. 42 N., R. 80 W.

A1—0 to 3 inches, grayish-brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; fine granular structure; hard, very firm, sticky and plastic; few roots; strong effervescence; strongly alkaline; clear, smooth boundary.

AC—3 to 11 inches, olive-gray (5Y 5/2) clay, olive gray (5Y 4/2) moist; massive; extremely hard, firm, very sticky and plastic; few roots; strong effervescence; strongly alkaline; clear, smooth boundary.

C1cacs—11 to 27 inches, light brownish-gray (2.5Y 6/2) clay, grayish brown (2.5Y 5/2) moist; massive; extremely hard, very firm, very sticky and very plastic; few threads and specks of calcium carbonate and calcium sulfate; strong effervescence; very strongly alkaline; gradual, wavy boundary.

C2cacs—27 to 60 inches, olive-gray (5Y 5/2) silty clay, olive gray (5Y 4/2) moist; massive; very hard, very firm, very sticky and very plastic; few coarse concretions of calcium carbonate and calcium sulfate; strong effervescence; strongly alkaline.

Content of exchangable sodium is more than 15 percent in all but the uppermost few inches. Content of coarse fragments typically is less than 5 percent. Texture generally is clay loam, silty clay, or clay, and clay content ranges from 38 to 50 percent. These soils are strongly alkaline or very strongly alkaline throughout the profile.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 2 or 3 in chroma when dry or moist.

The C horizon ranges from 5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. This horizon has inconsistent accumulations of calcium carbonate and calcium sulfate.

Petrie silty clay (Pc).—This soil is on alluvial fans. Generally, it is in valleys that lead into drainageways and is nearly level to sloping, but in some areas it is on upland foot slopes and has slopes of 6 to 10 percent. It has a profile similar to the one described as representative of the series, except that the surface layer is about 4 to 6 inches thick.

Included with this soil in mapping are areas of Absted, Bone, and Cadoma soils.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used for irrigated pasture and for range. (Capability units VIs–71, dryland, and VIs–71, irrigated; Saline Lowland range site, 10 to 14 inch precipitation zone)

Petrie-Bone complex (PE).—This complex is about 40 percent Petrie silty clay, 0 to 6 percent slopes, and about 30 percent Bone loam, 0 to 6 percent slopes. These soils have the profiles described as representative of the Petrie and Bone series. They are on alluvial fans and are intermingled in a highly complex pattern.

Included with these soils in mapping are areas of Absted soils that make up about 20 percent of the acreage. Also included are areas of Kim soils that make up about 5 percent and areas of Limon soils that make up about 5 percent. Other inclusions, in areas of Absted soils, are soils similar to the Absted soils, except that the content of sodium is much higher in the subsoil.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

Soils of this complex are used for range and wildlife habitat. (Capability unit VIs–71, dryland. Petrie soil in Saline Lowland range site, 10 to 14 inch precipitation zone, and Bone soil in Dense Clay range site, 10 to 14 inch precipitation zone)

Pineguest Series

The Pineguest series consists of well-drained soils. These soils formed in alluvium weathered from granitic rock. They are on hillsides in the mountains. Slopes range from 10 to 30 percent. Elevations range from 8,000 to 9,500 feet. The average annual precipitation is 15 to 19 inches, and the average annual soil temperature is 39° F. The frost-free season is 60 to 65 days, although frost can occur during any month. The vegetation is Douglas-fir and lodgepole pine.

In a representative profile about 3 inches of forest litter covers a surface layer of brown, slightly acid sandy loam about 2 inches thick. The subsurface layer is medium acid gravelly loamy coarse sand about 13 inches thick. It is very pale brown in the upper 8 inches and mixed very pale brown and light yellowish brown in the lower 5 inches. The subsoil is light yellowish-brown, medium acid gravelly coarse sandy loam and gravelly loamy coarse sand about 16 inches thick. The substratum is light yellowish-brown, medium acid gravelly coarse sand that reaches to a depth of 60 inches or more.

Permeability is moderately rapid, and the available water capacity is low to moderate. The effective rooting depth is 40 to 60 inches or more.

These soils are used for woodland and wildlife habitat.

Representative profile of a Pineguest soil, in an area of Pineguest-Mathers association, a short distance north of the soil survey area boundary, in the SW¼SW¼ sec. 24, T. 47 N., R. 85 W.

O1—3 inches to 1 inch, undecomposed needles, bark, and twigs.

O2—1 inch to 0, partly decomposed organic material that consists of needles, bark, and twigs.

A1—0 to 2 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; moderate, fine, crumb structure; soft, very friable; a few charcoal fragments; slightly acid; clear, smooth boundary.

A2—2 to 10 inches, very pale brown (10YR 7/3) gravelly loamy coarse sand, brown (10YR 5/3) moist; moderate, medium, platy structure parting to moderate, fine, granular; slightly hard, very friable; 15 to 20 percent gravel, mostly fine and very fine angular fragments of granite of pebble size; medium acid; gradual, wavy boundary.

A&B—10 to 15 inches, mixed colors, including very pale brown (10YR 7/3) and light yellowish-brown (10YR 6/4) gravelly loamy coarse sand, brown (10YR 5/3) and yellowish brown (10YR 5/4) moist; weak, medium, subangular blocky structure; very hard, loose; this horizon consists of thin seams and nodules of clayey material embedded in material from the A2 horizon; 20 percent fine and very fine angular fragments of granite of pebble size; medium acid; gradual, wavy boundary.

B2t—15 to 26 inches, light yellowish-brown (10YR 6/4) gravelly coarse sandy loam, yellowish brown (10YR 5/4) moist; weak, medium, subangular blocky structure; very hard, loose; this horizon consists of seams and lamellae of sandy clay loam or clay loam, ½- to ¾-inch thick, embedded in a matrix of loamy coarse sand; thin, nearly continuous, waxlike coatings on ped faces in lamellae; waxlike coatings on sand grains and coarse fragments; waxlike bridgings between sand grains; 20 percent fine and very fine angular fragments of granite of pebble size; medium acid; gradual, wavy boundary.

B3—26 to 31 inches, light yellowish-brown (10YR 6/4) gravelly loamy coarse sand, yellowish brown (10YR 5/4) moist; weak, medium, subangular blocky structure; very hard, loose; some glossy coatings on sand grains and coarse fragments; 20 percent fine and very fine angular fragments of granite of pebble size; medium acid; diffuse, wavy boundary.

C—31 to 60 inches, light yellowish-brown (10YR 6/4) gravelly coarse sand, yellowish brown (10YR 5/4) moist; single grained; very hard, loose; noncalcareous; medium acid.

Depth to bedrock ranges from 40 to 60 inches or more, and thickness of the solum ranges from 20 to 50 inches. Content of coarse fragments ranges from about 15 to 35 percent. Most of the fragments are fine and very fine, angular, granite pebbles. These soils are slightly acid or medium acid throughout the profile.

The A2 horizon ranges from 2.5Y to 10YR in hue, ranges from 5 to 7 in value when dry and is 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. In most places the primary structure is platy, but in some places it is subangular blocky or granular. This horizon is hard or slightly hard when dry.

The B2t horizon ranges from 2.5Y to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 3 to 5 in chroma when dry or moist. In most places the primary structure is subangular blocky, but in and near lamellea, it is stronger.

The C horizon ranges from 2.5Y to 10YR in hue.

Pineguest-Mathers association (PG).—This association is about 50 percent Pineguest sandy loam, 10 to 30 percent slopes, and about 30 percent Mathers sandy loam, 10 to 30 percent slopes. These soils have the profiles described as representative of the Pineguest and Mathers series. They occupy timbered hillsides in the mountains. The Pineguest soil is on the upper hillsides, and the Mathers soil is below the Pineguest soil.

Included with these soils in mapping are areas of Rock land that make up about 15 percent of the acreage and areas of thin, stony soils that make up about 5 percent.

Runoff is rapid, and the hazard of erosion is high.

Soils of this association are used for woodland and wildlife habitat. The current tree species are Douglas-fir and Engelmann spruce in undisturbed areas and thick stands of 1- to 4-inch-diameter lodgepole pine on old burns, particularly on top of the Horn. Woodland production includes sawtimber, posts, and poles. Soils of this association are in woodland group 1. (Capability unit VIe–5, dryland; not in a range site)

Pokeman Series

The Pokeman series consists of well-drained soils. These soils formed in residuum weathered from gypsum bedrock on hillsides and in concave areas of the uplands. Slopes range from 6 to 15 percent. Elevations range from 5,000 to 5,800 feet. The average annual precipitation is 12 to 13 inches, the average annual soil temperature is about 49° F., and the frost-free season is 95 to 100 days. The vegetation is western wheatgrass, blue grama, cactus, and big sagebrush.

In a representative profile the surface layer is brown, mildly alkaline loam about 2 inches thick. The subsoil is reddish-brown, strongly alkaline clay loam about 5 inches thick. The substratum is light-brown or light-gray, strongly alkaline clay loam about 16 inches thick that is underlain by gypsum bedrock at a depth of about 30 inches.

Permeability and the available water capacity are moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Pokeman loam, in an area of Pokeman-Gystrum-Rekop association, in the NW¼NE¼ sec. 30, T. 41 N., R. 84 W.

A1—0 to 2 inches, brown (7.5YR 5/4) loam, dark reddish brown (5YR 3/3) moist; weak, thin, platy structure parting to moderate, fine, crumb; soft, very friable, slightly sticky and slightly plastic; mildly alkaline; clear, smooth boundary.

B2t—2 to 7 inches, reddish-brown (5YR 4/4) clay loam, dark reddish brown (5YR 3/4) moist; weak, medium, angular blocky structure; thin discontinuous clay films on vertical cleavages; slightly hard, firm, sticky and plastic; strong effervescence; strongly alkaline; clear, smooth boundary.

B3ca—7 to 14 inches, reddish-brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; weak, medium, angular blocky structure; thin discontinuous clay films on vertical cleavages; slightly hard, firm, sticky and plastic; moderate effervescence; clear, smooth boundary.

C1ca—14 to 18 inches, light-brown (7.5YR 6/4) clay loam, reddish brown (5YR 5/4) moist; structureless; slightly hard, firm, sticky and plastic; many, fine and medium, distinct threads and nodules of calcium carbonate; violent effervescence; strongly alkaline; abrupt, smooth boundary.

C2cacs—18 to 30 inches, light-gray (7.5YR 7/1) clay loam, pinkish gray (7.5YR 6/2) moist; structureless; soft, very friable, sticky and plastic; many fine and medium threads and nodules of calcium carbonate and calcium sulfate; violent effervescence; strongly alkaline; gradual, wavy boundary.

C3—30 inches, gypsum bedrock, hardness less than 3 (Mohs' scale).

Depth to bedrock ranges from 20 to 40 inches, and thickness of the solum is less than 15 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent.

The A1 horizon ranges from 7.5YR to 5YR in hue, is 5 or 6 in value when dry and 3 to 5 when moist, and ranges from 2 to 4 in chroma when dry and moist. It is mildly alkaline or moderately alkaline.

The B2t horizon ranges from 5YR to 2.5YR in hue, ranges from 4 to 6 in value when dry and from 3 to 5 when moist, and is 4 or 5 in chroma when dry or moist. In most places it has weak, prismatic structure, but in some places it has subangular blocky structure. It is moderately alkaline or strongly alkaline.

The C2cacs horizon ranges from 7.5YR to 2.5YR in hue. It is moderately alkaline or strongly alkaline.

Pokeman-Gystrum-Rekop complex, hilly (PKD).—This complex is about 40 percent Pokeman loam, 6 to 15 percent slopes; about 25 percent Gystrum silt loam, 10 to 30 percent slopes; and about 20 percent Rekop loam, 10 to 30 percent slopes. These soils have the profiles described as representative of the Pokeman, Gystrum, and Rekop series. They occupy uplands on the lower flanks of mountains. The Pokeman soil is on the lower hillsides and in concave areas, the Gystrum soil is on convex hillsides, and the Rekop soil is mainly on ridgetops.

Included with these soils in mapping are areas of Rock land that make up about 10 percent of the acreage and areas of shallow, reddish-colored soils similar to Spearfish soils that make up about 5 percent.

Runoff is rapid, and the hazard of erosion is high.

Soils of this complex are used for range and wildlife habitat. (Capability unit VIe–2, dryland. Pokeman and Gystrum soils in Loamy range site, 10 to 14 inch precipi-

tation zone, and Rekop soil in Shallow Loamy range site, 10 to 14 inch precipitation zone)

Poker Series

The Poker series consists of rolling or hilly, well-drained soils. These soils formed in residuum weathered from reddish-colored sandstone on mountainsides. Slopes range from 6 to 20 percent. Elevations range from 8,000 to 9,500 feet. The average annual precipitation is 17 to 18 inches, and the average annual soil temperature is about 40° F. The frost-free season is about 65 days, although frost can occur during any month. The vegetation is mountain grasses and sedges, but Idaho fescue is dominant.

In a representative profile the surface layer is dark grayish-brown or dark-brown, neutral or slightly acid sandy loam about 6 inches thick. The subsoil is reddish-brown, slightly acid sandy loam about 12 inches thick. The substratum is reddish-brown, slightly acid sandy loam, about 12 inches thick, that is underlain by reddish-brown sandstone at a depth of about 30 inches.

Permeability is moderately rapid, and the available water capacity is low to moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Poker sandy loam, in an area of Poker-Bachus-Splitro association, 100 yards northwest of Tobin Cabin in Davis Mountain Camp, in the NE¼NE¼ sec. 5, T. 44 N., R. 85 W.

A11—0 to 2 inches, dark grayish-brown (10YR 4/2) sandy loam, dark reddish brown (5YR 2/2) moist; weak, fine, crumb structure; soft, very friable; many roots; neutral; clear, smooth boundary.

A12—2 to 6 inches, dark-brown (10YR 3/3) sandy loam, dark reddish brown (5YR 2/2) moist; moderate, fine and medium, crumb structure; soft, very friable; many roots; slightly acid; clear, smooth boundary.

B2t—6 to 18 inches, reddish-brown (5YR 4/3) sandy loam, dark reddish brown (5YR 3/2) moist; weak, coarse, angular blocky structure; clay films as bridgings between sand grains and coatings on sand grains; soft, very friable; many roots throughout; few, hard, sandstone fragments; slightly acid; gradual, wavy boundary.

C1—18 to 30 inches, reddish-brown (5YR 4/3) sandy loam, dark reddish brown (5YR 3/2) moist; massive; soft, very friable; very few roots; many, 2- to 5-inch, sandstone fragments; slightly acid; gradual, wavy boundary.

C2—30 inches, reddish-brown, noncalcareous sandstone.

Depth to bedrock ranges from 20 to 40 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 10 percent. These soils range from slightly acid to mildly alkaline throughout the profile.

The A1 horizon ranges from 10YR to 2.5YR in hue, is 3 or 4 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. It is generally sandy loam or fine sandy loam.

The B2t horizon ranges from 5YR to 2.5YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and ranges from 2 to 4 in chroma when dry and is 2 or 3 when moist. The clay content of this horizon ranges from 8 to 18 percent. This horizon extends to bedrock in some places.

Poker-Bachus-Splitro association (PM).—This association is about 40 percent Poker sandy loam, 6 to 20 percent slopes; about 25 percent Bachus loam, 6 to 20 percent slopes; and about 20 percent Splitro sandy loam, 6 to 30 percent slopes (fig. 9.). These soils have the profiles described as representative of the Poker, Bachus, and Splitro series. They are in the mountains. The Poker soil is on the lower hillsides, the Bachus soil is on rounded upland ridges, and the Splitro soil is on the upper ridges and ridge crests.

Included with these soils in mapping are areas of Sublette soils that make up about 10 percent of the acreage and areas of slabby sandstone outcrops that make up about 5 percent.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

Soils of this association are used for range and wildlife habitat. (Poker soil in capability unit VIe–5, dryland, and Sandy range site, 15 to 19 inch precipitation zone. Bachus soil in capability unit VIe–2, dryland, and Loamy range site, 15 to 19 inch precipitation zone. Splitro soil in capability unit VIIe–14, dryland, and Shallow Loamy range site, 15 to 19 inch precipitation zone)

Potts Series

The Potts series consists of well-drained soils. These soils formed in reddish-colored alluvium derived from red sandstone and siltstone. They are on foot slopes and alluvial fans. Slopes range from 6 to 20 percent. Elevations range from 5,000 to 6,000 feet. The average annual precipitation is about 12 inches, the average annual soil temperature is about 50° F., and the frost-free season is 95 to 100 days. The vegetation is western wheatgrass, blue grama, and threadleaf sedge.

In a representative profile the surface layer is brown, neutral loam about 4 inches thick. The subsoil is reddish-brown, neutral to moderately alkaline loam or clay loam about 20 inches thick. The substratum is reddish-brown, moderately alkaline loam that reaches to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more.

These soils are used for range and wildlife habitat.

Representative profile of Potts loam, in an area of Potts-Kirtley association, in the SW¼NW¼ sec. 35, T. 44 N., R. 83 W.

A1—0 to 4 inches, brown (7.5YR 5/3) loam, dark brown (7.5YR 4/3) moist; weak, medium, subangular blocky structure parting to strong, very fine, granular; soft, very friable; neutral; clear, smooth boundary.

B1—4 to 7 inches, reddish-brown (5YR 5/3) loam, reddish brown (5YR 4/3) moist; weak to moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, very friable; few, thin, patchy clay films on some soil aggregates; neutral; clear, smooth boundary.

B2—7 to 16 inches, reddish-brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, very friable; many, thin, patchy clay films on horizontal and vertical faces of soil aggregates; mildly alkaline; gradual, wavy boundary.

B3ca—16 to 24 inches, reddish-brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, very friable; few, thin, patchy clay films on some aggregate faces; this is a moderate ca horizon that has visible secondary calcium carbonate occurring as concretions and in thin seams and streaks; strong effervescence; moderately alkaline; gradual, wavy boundary.

Figure 9.—In foreground is an area of Poker-Bachus-Splitro association. In background are the Big Horn Mountains.

Cca—24 to 60 inches, reddish-brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; massive; hard, very friable; this is a moderate ca horizon that has visible secondary calcium carbonate occurring as concretions and in thin seams and streaks; strong effervescence; moderately alkaline.

Depth to calcareous material ranges from 8 to 20 inches, and thickness of the solum ranges from 15 to 30 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent.

The A1 horizon ranges from 7.5YR to 5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It is neutral or mildly alkaline and is soft or slightly hard when dry.

The B2t horizon ranges from 2.5YR to 5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 3 to 6 in chroma when dry or moist. It ranges from neutral to moderately alkaline, and it generally is slightly calcareous in the lower part. It is generally loam or clay loam, and the clay content ranges from about 18 to 35 percent.

The Cca horizon ranges from 7.5YR to 2.5YR in hue. It is moderately alkaline or very strongly alkaline.

Potts-Kim association (PS).—This association is about 50 percent Potts loam, 6 to 20 percent slopes, and about 30 percent Kim loam, 6 to 20 percent slopes. These soils occupy alluvial fans and foothills immediately east of the red beds. The Potts soil is on the lower foot slopes, and the Kim soil is on alluvial fans above the Potts soil as well as on recent deposits on valley floors.

Included with these soils in mapping are areas of Travessilla soils that make up about 10 percent of the acreage. Also included are areas of Kirtley soils that make up about 5 percent and areas of soils that formed in alluvium and are similar to Barnum soils and that make up about 5 percent.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

Soils of this association are used for range and wildlife habitat. (Capability unit VIe–2, dryland; Loamy range site, 10 to 14 inch precipitation zone)

Potts-Kirtley association (PT).—This association is about 40 percent Potts loam, 6 to 20 percent slopes; about 25 percent Kirtley loam, 6 to 15 percent slopes; and about 20 percent Shingle loam, 10 to 30 percent slopes. The Potts soil has the profile described as representative of the Potts series. These soils are on ridges, hillsides, and foot slopes. The Potts soil is on foot slopes, the Kirtley soil is on uplands, and the Shingle soil is on ridge crests and hillsides.

Runoff is medium to rapid on the Potts and Kirtley soils and rapid on the Shingle soil. The hazard of erosion is moderate to high on the Potts and Kirtley soils and high on the Shingle soil.

Soils of this association are used for range and wildlife habitat. (Potts and Kirtley soils in capability unit VIe–2, dryland, and Loamy range site, 10 to 14 inch precipitation zone. Shingle soil in capability unit VIIe–14, dryland, and Shallow Loamy range site, 10 to 14 inch precipitation zone)

Pugsley Series

The Pugsley series consists of well-drained soils. These soils formed in residuum weathered from noncalcareous, reddish-colored sandstone on upland ridges and hillsides. Slopes range from 6 to 15 percent. Elevations range from

5,000 to 5,500 feet. The average annual precipitation is 12 to 13 inches, the average annual soil temperature is about 50° F., and the frost-free season is 100 to 105 days. The vegetation is big sagebrush, needle-and-thread, blue grama, and cactus.

In a representative profile the surface layer is light brownish-gray, neutral sandy loam about 4 inches thick. The subsoil is light brownish-gray, brown, or pale-brown, neutral sandy clay loam or sandy loam about 20 inches thick that is underlain by soft sandstone bedrock at a depth of about 24 inches.

Permeability is moderately rapid, and the available water capacity is low to moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Pugsley sandy loam, in an area of Briggsdale-Pugsley association, in the SE¼SE¼ sec. 3, T. 41 N., R. 77 W.

A1—0 to 4 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; moderate, very fine, granular structure; soft, very friable; neutral; clear, smooth boundary.

B1—4 to 7 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; weak, medium, subangular blocky structure parting to moderate, medium, granular; slightly hard, very friable; some glossy coatings on sand grains; a few waxlike coatings and bridgings between sand grains; neutral; clear, smooth boundary.

B2t—7 to 20 inches, brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, very friable; peds are hard; many waxlike patches and seams on ped faces; glossy coatings on sand grains; waxlike bridgings between sand grains; neutral; clear, smooth boundary.

B3—20 to 24 inches, pale-brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; massive; soft, loose; thin glossy coatings on some sand grains; neutral; abrupt, smooth boundary.

C—24 inches, soft sandstone bedrock.

Depth to bedrock ranges from 20 to 40 inches, and thickness of the solum ranges from 15 to 30 inches.

The A1 horizon ranges from 2.5Y to 10YR in hue, ranges from 5 to 7 in value when dry and is 4 or 5 when moist, and is 2 or 3 in chroma when dry or moist.

The B2t horizon ranges from 7.5YR to 5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 3 or 4 in chroma when dry or moist. It ranges from neutral to mildly alkaline. In most places the primary structure is prismatic, but in some places it is subangular blocky.

Pugsley-Gateson association (PU).—This association is about 35 percent Pugsley sandy loam, 6 to 15 percent slopes; about 25 percent Gateson loam, 10 to 30 percent slopes; and about 20 percent Embry sandy loam, 6 to 20 percent slopes. These soils are on Pine Ridge in the southeastern part of the survey area. They occupy high ridges, hillsides, and narrow valleys. The Pugsley soil is on the upper hillsides below the ridge crests, the Gateson soil is on north-facing hillsides under a cover of pine trees, and the Embry soil is on hillsides beneath sandstone ledges and areas dominated by sandstone bedrock.

Included with these soils in mapping are areas of Schooner soils that make up about 10 percent of the acreage. Also included are areas of Rencalson soils that make up about 5 percent and areas of soils that are similar to Gateson soils, are under pine trees, and make up about 5 percent.

Runoff is medium to rapid on the Pugsley and Embry soils and rapid on the Gateson soil. The hazard of erosion is high on the Gateson soil. The hazard of water erosion is moderate or high on the Pugsley and Embry soils, and if the cover is destroyed, the hazard of wind erosion is high on these soils.

Soils of this association are used for woodland, range, and wildlife habitat. The Gateson part of this association is in woodland group 5. (Pugsley and Embry soils in capability unit VIe-5, dryland. Pugsley soil in Loamy range site, 10 to 14 inch precipitation zone; Embry soil in Sandy range site, 10 to 14 inch precipitation zone. Gateson soil in capability unit VIe-2, dryland; not in a range site)

Pugsley-Southfork complex, hilly (PXD).—This complex is about 30 percent Pugsley sandy loam, 6 to 15 percent slopes; about 30 percent Southfork loamy sand, 10 to 30 percent slopes; and about 20 percent Tassel sandy loam, 15 to 40 percent slopes. The Southfork soil has the profile described as representative of the Southfork series. These soils occupy ridges and hillsides. The Pugsley soil is on the lower hillsides, the Southfork soil is on the upper hillsides and on rounded ridges, and the Tassel soil is on ridges.

Included with these soils in mapping are areas of Shingle soils that make up about 10 percent of the acreage. Also included are areas of Maysdorf soils that make up about 5 percent and areas of Rock outcrop that make up about 5 percent.

Runoff is medium to rapid on the Pugsley and Southfork soils, rapid on the Tassel soil. The hazard of water erosion is moderate to high on the Pugsley and Southfork soils and high on the Tassel soil. If the cover is destroyed, the hazard of wind erosion is high on all the soils.

Soils of this association are used for range and wildlife habitat. (Capability unit VIIe-14, dryland. Pugsley soil in Loamy range site, 10 to 14 inch precipitation zone, and Southfork and Tassel soils in Shallow Sandy range site, 10 to 14 inch precipitation zone)

Razor Series

The Razor series consists of gently sloping to moderately steep, well-drained soils. These soils formed in residuum weathered from calcareous shale on hillsides. Slopes range from 3 to 20 percent. Elevations range from 4,500 to 5,000 feet. The average annual precipitation is 10 to 12 inches, the average annual soil temperature is about 52° F., and the frost-free season is 105 to 110 days. The vegetation is big sagebrush, western wheatgrass, and green needlegrass.

In a representative profile the surface layer is pale-olive, moderately alkaline silty clay loam about 2 inches thick. The subsoil is olive-colored, strongly alkaline silty clay about 10 inches thick. The substratum is olive-colored, strongly alkaline silty clay, about 12 inches thick, that is underlain by shale at a depth of about 24 inches.

Permeability is slow, and the available water capacity is low to moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Razor silty clay loam, in an

area of Renohill-Razor association, rolling, in the SE¼NE¼ sec. 21, T. 44 N., R. 78 W.

A1—0 to 2 inches, pale-olive (5Y 6/3) silty clay loam, olive (5Y 5/3) moist; moderate, fine, crumb structure; slightly hard, firm, sticky and plastic; many roots; slight effervescence; moderately alkaline; clear, smooth boundary.

B2—2 to 12 inches, olive (5Y 4/3) silty clay, olive (5Y 4/4) moist; moderate, fine, angular blocky structure; thin discontinuous clay films; hard, very firm, very sticky and plastic; few roots; strong effervescence; strongly alkaline; clear, smooth boundary.

C1ca—12 to 24 inches, olive (5Y 5/3) silty clay; very weak, medium, subangular blocky structure; few very faint clay films; hard, very firm, very sticky and plastic; many, coarse, distinct spots of calcium carbonate; very few roots; strong effervescence; strongly alkaline; clear, smooth boundary.

C2—24 inches, stratified soft gray shale and hard olive-yellow shale.

These soils generally are calcareous to the surface, but in places they are noncalcareous in the uppermost 4 to 6 inches. Depth to bedrock ranges from 20 to 40 inches but generally is 22 to 30 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent.

The A1 horizon ranges from 2.5Y to 5Y in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It is mildly alkaline or moderately alkaline.

The B2 horizon ranges from 2.5Y to 5Y in hue, ranges from 4 to 6 in value when dry and is 4 or 5 when moist, and ranges from 3 to 5 in chroma when dry or moist. It is generally silty clay, but in places it is clay loam or clay. The B2 and C1ca horizons are moderately alkaline or strongly alkaline.

Razor-Gaynor-Samsil complex, hilly (RAD).—This complex is about 40 percent Razor silty clay loam, 6 to 20 percent slopes; about 25 percent Gaynor silty clay, 6 to 20 percent slopes; and about 20 percent Samsil silty clay, 10 to 30 percent slopes. The Gaynor and Samsil soils have the profiles described as representative of the Gaynor and Samsil series. These soils are on upland ridges and hillsides. Generally, the Razor soil is on hillsides below the Gaynor soil, the Gaynor soil is on the upper hillsides and on rounded ridges, and the Samsil soil is on ridge crests and hillsides.

Included with these soils in mapping are areas of Renohill soils that make up about 10 percent of the acreage and areas of Cadoma soils that make up about 5 percent.

Runoff is medium to rapid on the Razor soil and rapid on the Gaynor and Samsil soils. The hazard of erosion is moderate to high on the Razor soil and high on the Gaynor and Samsil soils.

Soils of this complex are used for range and wildlife habitat. (Capability unit VIe–1, dryland. Razor and Gaynor soils in Clayey range site, 10 to 14 inch precipitation zone, and Samsil soil in Shallow Clayey range site, 10 to 14 inch precipitation zone)

Redbank Series

The Redbank series consists of well-drained soils. These soils formed in reddish-colored alluvium on flood plains. Slopes range from 0 to 3 percent. Elevations range from 5,000 to 5,500 feet. The average annual precipitation is 12 to 13 inches, the average annual soil temperature is about 50° F., and the frost-free season is 100 to 105 days. The vegetation is common reedgrass, basin wildrye, and western wheatgrass.

In a representative profile the surface layer is reddish-brown, moderately alkaline fine sandy loam about 5 inches thick. The underlying layer is reddish-brown, moderately alkaline fine sandy loam that is stratified with thin lenses of loam and loamy sand and reaches to a depth of 60 inches or more.

Permeability is moderately rapid, and the available water capacity is moderate. The effective rooting depth is 60 inches or more. The seasonal high water table is below a depth of 40 inches, but the soils are flooded occasionally.

These soils are used for range and wildlife habitat.

Representative profile of Redbank fine sandy loam, in an area of Barnum-Redbank association, in the SW¼NE¼ sec. 6, T. 41 N., R. 83 W.

A1—0 to 5 inches, reddish-brown (5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; moderate, fine, granular structure; soft, very friable; strong effervescence; moderately alkaline; abrupt, smooth boundary.

C—5 to 60 inches, reddish-brown (2.5YR 5/5) fine sandy loam stratified with thin lenses of loam and loamy sand, reddish brown (2.5YR 4/5) moist; massive; slightly hard, very friable; strong effervescence; moderately alkaline.

These soils generally are calcareous throughout, but in places they are noncalcareous in the uppermost 1 or 2 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent.

The A horizon ranges from 7.5YR to 2.5YR in hue, is 5 or 6 in value when dry and ranges from 3 to 5 when moist, and ranges from 3 to 6 in chroma when dry and from 2 to 4 when moist. Where the A horizon has a color value as dark as 5 when dry and 3 when moist, it is less than 4 inches thick. It ranges from mildly alkaline to strongly alkaline. In most places the primary structure is granular, but in some places it is subangular blocky. This horizon is soft or slightly hard when dry.

The C horizon ranges from 5YR to 10R in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 3 to 6 in chroma when dry and from 3 to 5 when moist. It is moderately alkaline or strongly alkaline. Generally, it is fine sandy loam, but in some places it is loamy sand or loam.

Redbank soils are mapped in an association with Barnum soils.

Rekop Series

The Rekop series consists of moderately steep or steep, well-drained to somewhat excessively drained soils. These soils formed in residuum weathered from gypsum bedrock on uplands. Slopes range from 10 to 30 percent. Elevations range from 5,000 to 5,800 feet. The average annual precipitation is 12 to 13 inches, the average annual soil temperature is about 49° F., and the frost-free season is 95 to 100 days. The vegetation is threadleaf sedge, yucca, and cactus.

In a representative profile the surface layer is light-brown, strongly alkaline loam about 4 inches thick. The underlying layer is pink or pinkish-white, strongly alkaline gravelly loam, about 15 inches thick, that is underlain by soft, weathered gypsum at a depth of about 19 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is 10 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Rekop loam, in an area of Pokeman-Gystrum-Rekop complex, hilly, in the SW¼-NW¼ sec. 11, T. 42 N., R. 84 W.

A1—0 to 4 inches, light-brown (7.5YR 6/4) loam, dark brown (7.5YR 4/4) moist; weak, fine, crumb structure; soft, very friable, slightly sticky; violent effervescence; strongly alkaline; clear, smooth boundary.

C1cacs—4 to 10 inches, pink (7.5YR 7/4) gravelly loam, brown (7.5YR 5/4) moist; weak, fine, angular blocky structure; soft, very friable, slightly sticky and slightly plastic; many, common, fine, distinct threads and nodules of calcium carbonate and calcium sulfate; violent effervescence; strongly alkaline; gradual, wavy boundary.

C2cacs—10 to 19 inches, pinkish-white (7.5YR 8/2) gravelly loam, pink (7.5YR 7/4) moist; structureless; soft, very friable, slightly sticky and slightly plastic; few fine specks of secondary calcium carbonate and calcium sulfate; 20 to 30 percent hard gypsum fragments; violent effervescence; strongly alkaline; clear, smooth boundary.

C3—19 inches, soft, gray, weathered gypsum.

Depth to bedrock ranges from 10 to 20 inches. Content of coarse fragments ranges from 0 to 35 percent but typically is about 10 percent. Texture generally is gravelly loam or loam, but content of clay ranges from 18 to 35 percent. These soils are moderately alkaline or strongly alkaline throughout the profile.

The A1 horizon ranges from 10YR to 5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 3 to 5 in chroma when dry or moist.

The C horizon ranges from 7.5YR to 2.5YR in hue, ranges from 5 to 8 in value when dry and from 5 to 7 when moist, and ranges from 2 to 5 in chroma when dry and from 3 to 6 when moist.

Rekop soils are mapped in a complex with Pokeman and Gystrum soils.

Rencalson Series

The Rencalson series consists of moderately steep, well-drained soils. These soils formed in residuum weathered from noncalcareous shale on uplands. Slopes range from 10 to 15 percent. Elevations range from 5,000 to 5,500 feet. The average annual precipitation is 11 to 12 inches, the average annual soil temperature is about 52° F., and the frost-free season is 95 to 100 days. The vegetation is big sagebrush, western wheatgrass, and green needlegrass.

In a representative profile the surface layer is grayish-brown, neutral loam about 5 inches thick. The subsoil is grayish-brown, brown, and light brownish-gray, neutral clay loam, about 27 inches thick, that is underlain by interbedded shale, siltstone, and soft standstone at a depth of about 32 inches.

Permeability is slow, and the available water capacity is moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Rencalson loam, in an area of Moret-Rencalson complex, hilly, in the SW¼SW¼ sec. 27, T. 43 N., R. 82 W.

A1—0 to 5 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; moderate, fine, granular and crumb structure; soft, very friable; neutral; clear, smooth boundary.

B1—5 to 9 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak, medium, prismatic structure parting to medium subangular blocky; slightly hard, very friable; individual peds are very hard; few, thin, glossy patches on ped faces; neutral; clear, smooth boundary.

B2t—9 to 23 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate, medium, prismatic structure parting to moderate, medium, angular blocky; hard, friable; peds are extremely hard; thin, nearly continuous, waxlike coatings on ped faces; thin waxlike coatings in root channels; neutral; gradual, wavy boundary.

B3—23 to 32 inches, light brownish-gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; weak, medium, subangular blocky structure; hard, friable; few, thin, glossy patches on ped faces and some glossy coatings in root channels; neutral; clear, smooth boundary.

C—32 inches, noncalcareous, interbedded shale, siltstone, and soft sandstone.

Depth to bedrock ranges from 20 to 40 inches, and thickness of the solum ranges from 15 to 40 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 2 or 3 in chroma when dry or moist. It ranges from medium acid to mildly alkaline. In most places the primary structure is granular or crumb, but in some places it is subangular blocky. The horizon is soft or slightly hard when dry.

The B2t horizon ranges from 2.5Y to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It is neutral or mildly alkaline. In most places the primary structure is prismatic, but in some places it is angular blocky. It is generally clay loam or clay.

Rencalson soils are mapped in a complex with Moret soils.

Renohill Series

The Renohill series consists of nearly level to moderately steep, well-drained soils. These soils formed in residuum weathered from shale on upland ridges and hillsides. Slopes range from 0 to 20 percent. Elevations range from 4,500 to 5,200 feet. The average annual precipitation is 10 to 12 inches, the average annual soil temperature is about 50° F., and the frost-free season is 100 to 120 days. The vegetation is western wheatgrass, big sagebrush, and green needlegrass.

In a representative profile the surface layer is light brownish-gray, neutral clay loam about 4 inches thick. The subsoil is grayish-brown, light olive-brown, and light yellowish-brown, mildly alkaline and moderately alkaline clay loam and clay about 16 inches thick. The substratum is light brownish-gray, moderately alkaline clay loam, about 10 inches thick, that is underlain by shale bedrock at a depth of about 30 inches.

Permeability is slow, and the available water capacity is moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range, to a limited extent for dryfarming, and as wildlife habitat.

Representative profile of Renohill clay loam, in an area of Renohill-Razor association, rolling, in the SW¼SW¼ sec. 9, T. 42 N., R. 80 W.

A1—0 to 4 inches, light brownish-gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) moist; strong, fine, granular structure; soft, very friable; neutral; clear, smooth boundary.

B1—4 to 7 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate, medium, subangular blocky structure parting to moderate granular; slightly hard, very friable; primary peds are hard; mildly alkaline; clear, smooth boundary.

B2t—7 to 14 inches, light olive-brown (2.5Y 5/3) clay, olive brown (2.5Y 4/3) moist; moderate, medium, prismatic structure parting to moderate, medium, angular

blocky; slightly hard, very friable, very plastic; peds are extremely hard; thin, nearly continuous, waxlike coatings and fillings in root channels and pores; mildly alkaline; clear, smooth boundary.

B3ca—14 to 20 inches, light yellowish-brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; weak, coarse, angular and subangular blocky structure; hard, firm, plastic; peds are extremely hard; few glossy patches on ped faces; some visible secondary calcium carbonate occurring as concretions; strong effervescence; moderately alkaline; gradual, smooth boundary.

Cca—20 to 30 inches, light brownish-gray (2.5Y 6/2) clay loam, grayish brown (2.5Y 5/2) moist; massive; very hard, firm; visible secondary calcium carbonate occurring as concretions and in thin seams and streaks; some partly weathered shale fragments; strong effervescence; moderately alkaline; gradual, smooth boundary.

C—30 to 40 inches, calcareous shale bedrock.

Depth to bedrock ranges from 20 to 40 inches, and depth to calcareous material ranges from 6 to 20 inches. Content of coarse fragments ranges from 0 to 15 percent but typically in less than 5 percent.

The A horizon ranges from 2.5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 2 or 3 in chroma when dry or moist. It is neutral or mildly alkaline. In most places the primary structure is granular or crumb, but in some places it is subangular blocky. This horizon is soft or slightly hard when dry.

The B2t horizon ranges from 2.5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 5 in chroma when dry or moist. It ranges from neutral to moderately alkaline. In most places the primary structure is prismatic, but in some places it is angular blocky. The content of clay ranges from 35 to 50 percent.

The C horizon ranges from 2.5Y to 10YR in hue. It is moderately alkaline or strongly alkaline.

Renohill clay loam, 0 to 6 percent slopes (RcB).—This soil is on uplands. It has a profile similar to the one described as representative of the Renohill series, except that the surface layer is about 6 inches thick.

Included with this soil in mapping are areas of Briggsdale and Razor soils.

Runoff is slow to medium, and the hazard of erosion is slight to moderate.

This soil is used for native range and for dryland spring wheat. (Capability unit IVe–1, dryland; Clayey range site, 10 to 14 inch precipitation zone)

Renohill clay loam, 6 to 14 percent slopes (RcC).—This soil is on hillsides. It has a profile similar to the one described as representative of the series, except that the surface layer is about 5 inches thick.

Included with this soil in mapping are areas of Briggsdale, Razor, and Gaynor soils.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used for range and, to a minor extent, for dryland spring wheat. (Capability unit VIe–1, dryland; Clayey range site, 10 to 14 inch precipitation zone)

Renohill-Danko association (RD).—This association is about 30 percent Renohill clay loam, 6 to 20 percent slopes; about 25 percent Danko clay, 10 to 30 percent slopes; about 15 percent Gaynor silty clay, 6 to 20 percent slopes; and about 15 percent Samsil silty clay, 10 to 30 percent slopes. The Danko soil has the profile described as representative of the Danko series. These soils occupy uplands. The Renohill and Gaynor soils are on smooth hillsides, and the Danko and Samsil soils are on ridges and areas above the drainageways.

Included with these soils in mapping are areas of Cadoma soils that make up about 10 percent of the acreage and areas of barren shale that make up about 5 percent.

Runoff is medium to rapid on the Renohill soil and rapid on the Danko, Gaynor, and Samsil soils. The hazard of erosion is moderate to high on the Renohill soil and high on the Danko, Gaynor, and Samsil soils.

Soils of this association are used for range and wildlife habitat. (Renohill and Gaynor soils in capability unit VIe–1, dryland, and Clayey range site, 10 to 14 inch precipitation zone. Danko and Samsil soils in capability unit VIIe–14, dryland, and Shallow Clayey range site, 10 to 14 inch precipitation zone)

Renohill-Razor association, undulating (REC).—This association is about 50 percent Renohill clay loam, 3 to 10 percent slopes; about 20 percent Razor silty clay loam, 3 to 10 percent slopes; and about 15 percent Samsil silty clay, 6 to 10 percent slopes. These soils are undulating or rolling and are on uplands. The Renohill and Razor soils are on hillsides, and the Samsil soils are on ridge crests.

Included with these soils in mapping are areas of Gaynor soils that make up about 10 percent of the acreage and areas of Cadoma soils that make up about 5 percent.

Runoff is medium on the Renohill and Razor soils and rapid on the Samsil soil. The hazard of erosion is moderate on the Renohill and Razor soils and high on the Samsil soil.

Soils of this association are used for range, as wildlife habitat, and to a lesser extent for dryland spring wheat. (Renohill and Razor soils in capability unit IVe–1, dryland, and Clayey range site, 10 to 14 inch precipitation zone. Samsil soil in capability unit VIIe–14, dryland, and Shallow Clayey range site, 10 to 14 inch precipitation zone)

Renohill-Razor association, rolling (RED).—This association is about 40 percent Renohill clay loam, 6 to 20 percent slopes; about 25 percent Razor silty clay loam, 6 to 20 percent slopes; and about 20 percent Samsil silty clay, 10 to 30 percent slopes. These Renohill and Razor soils have the profiles described as representative of the Renohill and Razor series. They are on upland ridges and hillsides. The Renohill and Razor soils are intermingled on hillsides, and the Samsil soils are on ridge crests.

Included with these soils in mapping are areas of Cadoma soils that make up about 10 percent of the acreage and areas of Gaynor soils that make up about 5 percent.

Runoff is medium to rapid on the Renohill and Razor soils and rapid on the Samsil soils. The hazard of erosion is moderate to high on the Renohill and Razor soils and high on the Samsil soils.

Soils of this association are used for range and wildlife habitat. (Renohill and Razor soils in capability unit VIe–1, dryland, and Clayey range site, 10 to 14 inch precipitation zone. Samsil soil in capability unit VIIe–14, dryland, and Shallow Clayey range site, 10 to 14 inch precipitation zone)

Rhoame Series

The Rhoame series consists of nearly level to moderately steep, well-drained soils. These soils formed in alluvial and colluvial sediments derived from noncal-

careous shale. They are on alluvial fans and colluvial slopes. Slopes range from 0 to 20 percent. Elevations range from 5,000 to 6,000 feet. The average annual precipitation is 12 to 13 inches, the average annual soil temperature is about 49° F., and the frost-free season is 95 to 100 days. The vegetation is western wheatgrass, big sagebrush, and green needlegrass.

In a representative profile the surface layer is light brownish-gray, neutral channery clay loam about 4 inches thick. The underlying layer is brown and grayish-brown, slightly acid channery clay and channery clay loam that reaches to a depth of 60 inches or more.

Permeability is slow, and the available water capacity is high. The effective rooting depth is 60 inches or more.

These soils are used for irrigated hay, pasture, and small grain and for range and wildlife habitat.

Representative profile of Rhoame channery clay loam in the SE¼SE¼ sec. 16, T. 41 N., R. 81 W.

A1—0 to 4 inches, light brownish-gray (10YR 6/2) channery clay loam, dark grayish brown (10YR 4/2) moist; strong, fine, granular and crumb structure; soft, very friable; 20 percent slate and hard shale fragments; neutral; clear, smooth boundary.

AC—4 to 8 inches, grayish-brown (10YR 5/2) channery clay loam, dark grayish brown (10YR 4/2) moist; weak, coarse, subangular blocky structure; slightly hard, very friable; 20 percent slate and hard shale channery fragments; slightly acid; gradual, smooth boundary.

C—8 to 60 inches, brown (10YR 5/3) channery clay, dark brown (10YR 4/3) moist; massive; hard, very plastic; 25 percent slate and hard shale; slightly acid.

Content of coarse fragments ranges from 0 to 25 percent but typically is more than 15 percent. The coarse fragments are mainly small slate fragments and partly metamorphosed shale chips. These soils are medium acid to mildly alkaline throughout the profile.

The A1 horizon ranges from 5Y to 10YR in hue, ranges from 5 to 7 in value when dry and is 3 or 4 when moist, and is 2 or 3 in chroma when dry or moist. Where the A1 horizon has a color value as dark as 5 when dry and 3 when moist, it is less than 4 inches thick. In most places the primary structure is crumb or granular, but in some places it is subangular blocky. This horizon is soft or slightly hard when dry.

The C horizon ranges from 5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 3 to 5 in chroma when dry or moist.

Rhoame silty clay, 0 to 6 percent slopes (RhB).—This soil is on alluvial fans. It has a profile similar to the one described as representative of the series, except that the surface layer is silty clay about 6 inches thick. In some areas the surface layer is clay loam.

Included with this soil in mapping are some areas of Heldt and Lohmiller soils.

Runoff is slow to medium, and the hazard of erosion is slight to moderate.

This soil is used for irrigated hay, pasture, and small grain and for range. (Capability units IVe–1, dryland, and IIIe–1, irrigated; Clayey range site, 10 to 14 inch precipitation zone)

Rhoame silty clay, 6 to 10 percent slopes (RhC).—This soil is on alluvial fans, mainly on valley foot slopes. It has a profile similar to the one described as representative of the series, except that the surface layer is silty clay about 6 inches thick.

Included with this soil in mapping are areas of Englewood, Limon, and Wormser soils.

Runoff is rapid, and the hazard of erosion is high.

This soil is used for irrigated hay, pasture, and small grain and for range. (Capability units VIe–1, dryland, and IVe–1, irrigated; Clayey range site, 10 to 14 inch precipitation zone)

Rhoame complex (RM).—This complex is mainly Rhoame channery clay loam, 0 to 6 percent slopes. This soil has the profile described as representative of the series. It is intermingled in a complex pattern with soils that are similar to Heldt soils, except that they have a darker colored surface layer. It is on alluvial fans in low-lying positions adjacent to intermittent streams.

Included with this soil in mapping are small areas of Limon soils, saline phase, other Limon soils, and some alluvial deposits of shale fragments.

Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Soils of this complex are used for range and as wildlife habitat. (Capability unit IVe–1, dryland; Clayey range site, 10 to 14 inch precipitation zone)

Rhoame-Moret complex, hilly (RND).—This complex is about 40 percent Rhoame channery clay loam, 6 to 20 percent slopes, and about 35 percent Moret clay loam, 10 to 30 percent slopes. These soils occupy upland ridges and colluvial slopes that are dissected by numerous drainageways. The Rhoame soil is on colluvial slopes, and the Moret soil is on upland ridges.

Included with these soils in mapping are exposed shale and bentonite beds that make up about 15 percent of the acreage, areas of Shirk soils that make up about 5 percent, and areas of soils that are similar to but darker colored than Rhoame soils and make up about 5 to 20 percent.

Runoff is medium to rapid on the Rhoame soil and rapid on the Moret soil. The hazard of erosion is moderate or high on the Rhoame soil and high on the Moret soil.

Soils of this complex are used for range and wildlife habitat. (Capability unit VIIe–14, dryland. Rhoame soil in Clayey range site, 10 to 14 inch precipitation zone, and Moret soil in Shallow Clayey range site, 10 to 14 inch precipitation zone)

Rock Land

Rock land (RO) consists of 70 to 90 percent barren rock and 10 to 30 percent shallow and very shallow, steep to very steep soils. The barren rock is granite, hard sandstone, and hard siltstone of various geological formations. These rocks do not weather to large amounts of sediment. The shallow and very shallow soils in places furnish limited grazing, although the vegetation is sparse. In many places scattered pine trees are part of the vegetation.

Rock land is used as wildlife habitat. (Capability unit VIIIs–83, dryland; not in a range site)

Rock Outcrop

Rock outcrop consists of bare bedrock, which is hard sandstone and limestone of various geologic formations. It is mapped in complexes with Simmont, Starley, Sunup, and Travessilla soils. (Not in a capability unit or range site)

Saline, Wet Land

Saline, wet land (SA) consists of nearly level to gently sloping, wet, saline areas that are at the base of foot slopes on alluvial fans. Because this land type has a fluctuating water table, it is wet during most of the growing season. It is moderately saline to strongly saline. Some areas of Saline, wet land, occur in the red beds near Mayoworth and Barnum, but the largest areas are on the alluvial fans along the North Fork of Powder River. The vegetation is limited to greasewood and salt-tolerant grasses, such as alkali sacaton.

Saline, wet land, is used for range, as wildlife habitat, and to a small extent for irrigated hay and pasture. (Capability units VIs–71, dryland, and VIs–71, irrigated; Saline Subirrigated range site, 10 to 14 inch precipitation zone)

Samsil Series

The Samsil series consists of sloping to steep, well-drained soils. These soils formed in residuum weathered from shale on upland ridges and hillsides. Slopes range from 6 to 40 percent. Elevations range from 4,500 to 5,500 feet. The average annual precipitation is 10 to 12 inches, the average annual soil temperature is about 53° F., and the frost-free season is 100 to 110 days. The vegetation is western wheatgrass and birdfoot sagebrush.

In a representative profile the surface layer is light olive-brown, moderately alkaline silty clay about 8 inches thick. The underlying layer is light yellowish-brown, strongly alkaline silty clay, about 5 inches thick, that is underlain by shale at a depth of about 13 inches.

Permeability is slow, and the available water capacity is low. The effective rooting depth is 8 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Samsil silty clay, in an area of Razor-Gaynor-Samsil complex, hilly, near the center of sec 2, T. 43 N., R. 78 W.

A1—0 to 2 inches, light olive-brown (2.5Y 5/4) silty clay, light olive brown (2.5Y 5/4) moist; weak, fine, crumb structure; loose, firm, very sticky and very plastic; many roots; slight effervescence; moderately alkaline; clear, smooth boundary.

AC—2 to 8 inches, light olive-brown (2.5Y 5/4) silty clay, light olive brown (2.5Y 5/4) moist; structureless and has many fine platelets of shale; hard, very firm, very sticky and plastic; very few roots; few coarse specks of calcium carbonate; strong effervescence; moderately alkaline; clear, smooth boundary.

C1—8 to 13 inches, light yellowish-brown (2.5Y 6/4) silty clay, light olive brown (2.5Y 5/4) moist; structureless and has many fine platelets of shale; hard, very firm, very sticky and plastic; strong effervescence; strongly alkaline; clear, wavy boundary.

C2—13 inches, slightly hard, olive-colored shale; strong effervescence.

Depth to bedrock ranges from 8 to 20 inches. Texture generally is silty clay that is 40 to 55 percent clay. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent. The coarse fragments are shale chips.

The A horizon ranges from 5Y to 10YR in hue, is 5 or 6 in value when dry and ranges from 4 to 6 when moist, and ranges from 3 to 5 in chroma when dry or moist. It ranges from mildly to strongly alkaline.

The C horizon ranges from 5Y to 10YR in hue, is 5 or 6 in value when dry and ranges from 4 to 6 when moist, and ranges from 3 to 5 in chroma when dry or moist. It is moderately alkaline or strongly alkaline.

Samsil-Gaynor-Cadoma complex, rolling (SCD).—This complex is about 35 percent Samsil silty clay, 10 to 30 percent slopes; about 20 percent Gaynor silty clay, 6 to 20 percent slopes; about 15 percent Cadoma silty clay loam, 6 to 20 percent slopes; and about 15 percent Razor silty clay loam, 6 to 20 percent slopes. These soils are on uplands and ridges. The Samsil soil is on ridge crests, the Gaynor soil is on the upper sides of ridges and the shoulders of ridgecrests, and the Razor and Cadoma soils are on the lower hillsides.

Included with these soils in mapping are areas of Orella soils that make up about 10 percent of the acreage and areas of Renohill soils that make up about 5 percent.

Runoff is medium to rapid on the Razor soil and rapid on the Samsil, Gaynor, and Cadoma soils. The hazard of erosion is moderate to high on the Razor soil and high on the Samsil, Gaynor, and Cadoma soils.

Soils of this complex are used for range and wildlife habitat. (Capability unit VIIe–14, dryland. Samsil soil in Shallow Clayey range site, 10 to 14 inch precipitation zone; Gaynor and Razor soils in Clayey range site, 10 to 14 inch precipitation zone; and Cadoma soil in Dense Clay range site, 10 to 14 inch precipitation zone)

Samsil-Renohill association (SE).—This association is about 40 percent Samsil silty clay, 10 to 30 percent slopes; about 25 percent Renohill clay loam, 6 to 20 percent slopes; and about 15 percent Wyarno clay loam, 6 to 15 percent slopes. These soils are on upland foot slopes and alluvial fans. The Samsil soil is on ridge crests and the shoulders of ridges, the Renohill soil is on the steeper foot slopes, and the Wyarno soil is on alluvial fans.

Included with these soils in mapping are areas of Shingle soils that make up about 10 percent of the acreage. Also included are areas of Gaynor soils that make up about 5 percent and areas of Rock outcrop that make up about 5 percent.

Runoff is rapid on the Samsil soil and medium to rapid on the Renohill and Wyarno soils. The hazard of erosion is high on the Samsil soil and moderate to high on the Renohill and Wyarno soils.

Soils of this association are used for range and wildlife habitat. (Samsil soil in capability unit VIIe–14, dryland, and Shallow Clayey range site, 10 to 14 inch precipitation zone. Renohill and Wyarno soils in capability unit VIe–1, dryland, and Clayey range site, 10 to 14 inch precipitation zone)

Samsil-Shale outcrop complex, steep (SDE).—This complex is about 25 percent Samsil silty clay, 10 to 30 percent slopes; about 25 percent Samsil silty clay, 30 to 40 percent slopes; and about 30 percent Shale outcrop. The more sloping Samsil soil has a profile similar to the one described as representative of the series, except that shale is at a depth of 8 to 10 inches. In some areas of this complex, there is a thin, gravelly to cobbly mantle on the surface. These soils are on uplands that consist of sharp to rounded ridges dissected by numerous drainageways. The Samsil soils are on ridges and hillsides, and Shale outcrop is on ridges and eroded hillsides and in drainageways.

Included with these soils in mapping are areas of Shingle soils that make up about 10 percent of the acreage. Also included are areas of Gaynor soils that make up about 5 percent and areas of Petrie soils that make up about 5 percent.

Runoff is rapid, and the hazard of erosion is high.

Soils of this complex are used for range and wildlife habitat. (Capability unit VIIe–14, dryland. Samsil silty clay, 10 to 30 percent slopes, in Shallow Clayey range site, 10 to 14 inch precipitation zone; Samsil silty clay, 30 to 40 percent slopes, in Very Shallow range site, 10 to 14 inch precipitation zone; Shale outcrop not in a range site)

Sanford Series

The Sanford series consists of sloping or moderately steep, well-drained soils. These soils formed in residuum weathered from sandstone. They are on timbered hillsides in the mountains. Slopes range from 6 to 20 percent. Elevations range from 7,800 to 9,000 feet. The average annual precipitation is 18 to 19 inches, and the average annual soil temperature is about 40° F. The frost-free season is 60 to 65 days, although frost can occur during any month. The vegetation is dominantly lodgepole pine.

In a representative profile 2 inches of forest litter covers a surface layer of light brownish-gray, slightly acid sandy loam about 2 inches thick. The subsurface layer is light-gray, medium acid fine sandy loam, about 11 inches thick, that has nodules of sandy clay loam in the lower 5 inches. The subsoil is very pale brown, slightly acid loamy sand, about 11 inches thick, that has patchy accumulations of nodules of sandy clay loam and is underlain by sandstone at a depth of about 24 inches.

Permeability is moderately rapid, and the available water capacity is low. The effective rooting depth is 20 to 40 inches.

These soils are used for woodland, wildlife habitat, and watershed.

Representative profile of Sanford sandy loam, in an area of Sanford-Wetterhorn association, near the center of sec. 3, T. 46 N., R. 85 W.

O1—2 inches to 1 inch, conifer needles, twigs, and cones.

O2—1 inch to 0, decomposed needles, twigs, and cones.

A1—0 to 2 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) moist; moderate, coarse, granular structure parting to weak, very fine, granular; soft, very friable; very few angular fragments of fine-grained sandstone throughout; slightly acid, abrupt, wavy boundary.

A2—2 to 8 inches, light-gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) moist; moderate, thin, platy structure parting to weak, fine, crumb; soft, very friable; medium acid; abrupt, wavy boundary.

A&B—8 to 13 inches, light-gray (10YR 7/2) fine sandy loam matrix surrounding lamellae and isolated nodules of sandy clay loam; structureless; soft, very friable; medium acid; abrupt, wavy boundary.

B2t—13 to 24 inches, very pale brown (10YR 7/4) loamy sand matrix surrounding lamellae and nodules of sandy clay loam, brown (10YR 5/3) moist; weak, fine, subangular blocky structure; soft, very friable; few, fine, distinct mottles of light yellowish brown (10YR 6/5) moist; not indicative of reduction; few angular fragments of fine-grained sandstone; slightly acid; abrupt, wavy boundary.

R—24 inches, noncalcareous, fine-grained, weakly cemented sandstone.

Depth of bedrock ranges from 20 to 40 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is about 5 percent.

The A1 horizon ranges from 10YR to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry and is 2 or 3 when moist. It is slightly acid or medium acid. The A2 and A&B horizons range from 2.5Y to 7.5YR in hue, are 6 or 7 in value when dry and range from 4 to 6 when moist, and range from 2 to 4 in chroma when dry or moist. They range from medium acid to neutral.

The B2t horizon ranges from 2.5Y to 7.5YR in hue, ranges from 5 to 7 in value when dry and is 4 or 5 when moist, and ranges from 3 to 5 in chroma when dry or moist. It ranges from medium acid to neutral.

Sanford-Wetterhorn association (SF).—This association is about 50 percent Sanford sandy loam, 6 to 20 percent slopes, and about 35 percent Wetterhorn sandy loam, 6 to 20 percent slopes. These soils have the profiles described as representative of the Sanford and Wetterhorn series. They are on timbered hillsides in the mountains.

Included with these soils in mapping are areas of Starley soils that make up about 10 percent of the acreage and areas of Nathrop soils that make up about 5 percent.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

Soils of this association are used for woodland, wildlife habitat, and watershed. The dominant tree species is lodgepole pine. Woodland production includes sawtimber, posts, and poles. Soils of this association are in woodland group 2. (Sanford soil in capability unit VIe–5, dryland; Wetterhorn soil in capability unit VIe–2, dryland. Not in a range site)

Sawcreek Series

The Sawcreek series consists of sloping or moderately steep, well-drained soils. These soils formed in residuum weathered from sandstone on hillsides in the mountains. Slopes range from 6 to 20 percent. Elevations range from 7,500 to 9,000 feet. The average annual precipitation is 17 to 19 inches, and the average annual soil temperature is about 42° F. The frost-free season is 60 to 65 days, although frost can occur during any month. The vegetation is mountain grasses and sedges, but Idaho fescue is dominant.

In a representative profile the surface layer is grayish-brown or brown, slightly acid sandy loam about 9 inches thick. The subsoil is light-brown, slightly acid sandy loam about 12 inches thick. The substratum is light-brown, slightly acid sandy loam, about 9 inches thick, that is underlain by soft sandstone bedrock at a depth of about 30 inches.

Permeability is moderately rapid, and the available water capacity is low to moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Sawcreek sandy loam, in an area of Tripit-Sawcreek association, in the NE¼NE¼ sec. 32, T. 46 N., R. 84 W.

A11—0 to 5 inches, grayish-brown (10YR 5/2) sandy loam, very dark grayish brown (10YR 3/2) moist; strong, fine and very fine, granular and crumb structure; soft, very friable; slightly acid; clear, smooth boundary.

A12—5 to 9 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; weak, medium, subangular blocky structure; slightly hard, very friable; slightly acid; clear, smooth boundary.

B2—9 to 21 inches, light-brown (7.5YR 6/3) sandy loam, dark brown (7.5YR 4/3) moist; moderate, medium, sub-

angular blocky structure; slightly hard, very friable; slightly acid; gradual, wavy boundary.

C1—21 to 30 inches, light-brown (7.5YR 6/3) sandy loam, brown (7.5YR 5/3) moist; massive; soft, very friable; 10 percent gravel, mostly small sandstone fragments; slightly acid; clear, smooth boundary.

C2—30 inches, noncalcareous, soft, sandstone bedrock.

Depth to bedrock ranges from 20 to 40 inches, and thickness of the solum ranges from 15 to 30 inches. Texture of the B2 and C horizons typically is sandy loam, but content of clay ranges from 15 to 18 percent, that of silt from 5 to 30 percent, and that of sand from 52 to 80 percent. More than 35 percent of the sand is fine sand or coarser. Content of coarse fragments ranges from 0 to 15 percent in most of these horizons. These soils are slightly acid or neutral throughout the profile.

The A1 horizon ranges from 10YR to 7.5YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. In most places the primary structure is granular or crumb, but in some places it is subangular blocky. This horizon is soft or slightly hard when dry.

The B2 horizon ranges from 10YR to 5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 3 or 4 in chroma when dry or moist. In most places the primary structure is subangular blocky, but in some places it is prismatic.

The C horizon ranges from 10YR to 7.5YR in hue.

Sawcreek soils are mapped in an association with Tripit soils.

Schooner Series

The Schooner series consists of moderately steep or steep, well-drained soils. These soils formed in residuum weathered from hard, reddish-colored sandstone on ridges. Slopes range from 10 to 30 percent. Elevations range from 4,500 to 5,500 feet. The average annual precipitation is 12 to 14 inches, the average annual soil temperature is about 52° F., and the frost-free season is 100 to 105 days. The vegetation is needle-and-thread, threadleaf sedge, and blue grama.

In a representative profile the surface layer is light-brown, neutral loamy sand about 2 inches thick. The underlying layer is red, neutral fine sand about 12 inches thick that is underlain by hard, red sandstone at a depth of about 14 inches.

Permeability is rapid, and the available water capacity is low. The effective rooting depth is 10 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Schooner loamy sand, in an area of Maysdorf-Schooner association, in the NW¼NE¼ sec. 21, T. 43 N., R. 77 W.

A1—0 to 2 inches, light-brown (7.5Y 6/4) loamy sand, reddish brown (5YR 4/4) moist; single grained; soft, loose; many roots; neutral; clear, smooth boundary.

C—2 to 14 inches, red (2.5YR 5/6) fine sand, red (2.5YR 4/6) moist; single grained; loose; few roots; neutral; clear, smooth boundary.

R—14 inches, hard, red, noncalcareous sandstone.

Depth to bedrock ranges from 10 to 20 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent. These soils are medium acid to mildly alkaline throughout the profile.

The A1 horizon ranges from 7.5YR to 2.5YR in hue, is 6 or 7 in value when dry and 4 or 5 when moist, and ranges from 3 to 6 in chroma when dry or moist. It is single grained or has granular structure. It is soft or loose when dry.

The C horizon ranges from 5YR to 10R in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 4 to 6 in chroma when dry or moist.

Schooner soils are mapped in an association with Maysdorf soils.

Shale Outcrop

Shale outcrop (SH) consists of outcrops of dark-gray shale intermingled with deposits of bentonite. It is sloping to steep and is on uplands. Intermingled with the shale outcrops and bentonite beds are small areas of shallow or very shallow soils. Shale outcrop is mainly along Alkali Creek west of the town of Kaycee, between the Middle Fork of Powder River and Murphy Creek, and along the South Fork of Powder River near the southern boundary of the survey area.

Shale outcrop is used for wildlife habitat and as a commercial source of bentonite. Areas of this land type contain many open bentonite pits. (Capability unit VIIIs–83, dryland; not in a range site)

Shale Rock Land

Shale rock land (SK) consists of 70 to 85 percent shale and 15 to 30 percent very shallow and shallow soils. It is steep to very steep and is on uplands. Areas of this land type are highly erodible and weather to large amounts of sediment. The barren rock consists of acid shale and alkaline shale and gypsum beds. Shale rock land occurs in areas of various sizes, from the eastern boundary of the survey area to the flanks of the mountains. Sizable areas are along Freeman Draw. The vegetation is very sparse grass, and in some areas there are scattered pine trees.

Runoff is very rapid, and the hazard of erosion is high.

Shale rock land is used for wildlife habitat and for very limited grazing. (Capability unit VIIIs–83, dryland; not in a range site)

Shingle Series

The Shingle series consists of gently sloping to steep, well-drained soils. These soils formed in residuum derived from sandstone and siltstone on ridgetops and hillsides. Slopes range from 3 to 40 percent. Elevations range from 4,500 to 5,200 feet. The average annual precipitation is 10 to 12 inches, the average annual soil temperature is about 51° F., and the frost-free season is 105 to 120 days. The vegetation is threadleaf sedge and blue grama.

In a representative profile these soils are light olive-brown or olive-yellow, moderately alkaline loam, about 14 inches thick, that is underlain by soft, olive shale.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is 8 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Shingle loam, in an area of Shingle-Kim association, valleys, in the NW¼NW¼ sec. 21, T. 45 N., R. 80 W.

A—0 to 3 inches, light olive-brown (2.5Y 5/4) loam, olive brown (2.5YR 4/4) moist; moderate, fine and medium, crumb structure; soft, very friable, slightly sticky and slightly plastic; many roots; strong effervescence; moderately alkaline; clear, smooth boundary.

C—3 to 14 inches, olive-yellow (2.5Y 6/6) loam, light olive brown (2.5Y 5/4) moist; weak, fine, angular blocky structure; many, olive-brown, shale platelets throughout; soft, very friable; few roots; violent effervescence; moderately alkaline; gradual, wavy boundary.

C2—14 inches, soft, calcareous, olive-colored shale.

These soils generally are calcareous to the surface, but in places they are noncalcareous in the uppermost 1 or 2 inches. Depth to soft bedrock ranges from 8 to 20 inches. The soils are loam or clay loam and have a clay content of 18 to 35 percent throughout the profile. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent.

The A horizon ranges from 5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 3 to 5 in chroma when dry or moist. It ranges from mildly alkaline to strongly alkaline. It is soft or slightly hard when dry. The C horizon ranges from 5Y to 10YR in hue, from 5 to 7 in value when dry and from 4 to 6 when moist, and from 3 to 6 in chroma when dry or moist. It is moderately alkaline or strongly alkaline.

Shingle clay loam (Sm).—This soil is undulating or rolling and is on upland ridgetops. It has a profile similar to the one described as representative of the series, except that it is clay loam throughout. It is in small areas on ridgetops and knolls in cultivated fields. Slopes are 3 to 10 percent.

Included with this soil in mapping are some areas of Cushman and Samsil soils.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used for dryland small grain and for range. In places it has been cultivated to maintain field alinement. (Capability unit VIIe–14, dryland; Shallow Clayey range site, 10 to 14 inch precipitation zone)

Shingle-Briggsdale association (SNa).—This association is about 45 percent Shingle loam, 10 to 30 percent slopes, and about 30 percent Briggsdale very fine sandy loam, 6 to 15 percent slopes. These soils are on rounded ridges and hillsides. The Shingle soil is on rounded ridgetops and the shoulders of ridges, and the Briggsdale soil is on hillsides.

Included with these soils in mapping are areas of gravelly soils similar to Renohill soils that make up about 15 percent of the acreage. These soils differ from Renohill soils in that the surface layer and subsoil are gravelly. Also included are areas of Renohill soils that make up about 5 percent of the acreage and areas where both Razor and Worf soils occur and make up about 5 percent.

Runoff is rapid on the Shingle soil and medium to rapid on the Briggsdale soil. The hazard of erosion is high on the Shingle soil. The hazard of water erosion is moderate to high on the Briggsdale soil, and if the cover is destroyed, the hazard of wind erosion is high.

Soils of this association are used for range and wildlife habitat. (Shingle soil in capability unit VIIe–14, dryland, and Shallow Loamy range site, 10 to 14 inch precipitation zone. Briggsdale soil in capability unit VIe–2, dryland, and Loamy range site, 10 to 14 inch precipitation zone)

Shingle-Cushman association (SNb).—This association is about 40 percent Shingle loam, 10 to 30 percent slopes, and about 30 percent Cushman fine sandy loam, 6 to 20 percent slopes. These soils have the profiles described as representative of the Shingle and Cushman series, but in some areas they are noncalcareous and are underlain by hard bedrock. These soils are on upland ridges and hillsides. The Shingle soil is on ridge crests and the upper hillsides, and the Cushman soil is on the lower hillsides. On the drainageway that leads into Crazy Woman Creek on the east side of the Pine Ridge, areas of these soils are in drainageways.

Included with these soils in mapping are areas of Worf soils that make up about 15 percent of the acreage, areas of Kim soils that make up about 10 percent, and areas of Briggsdale soils that make up about 5 percent. Also included are areas of alluvial soils on narrow bottoms and alluvial fans on some of the drainageways that lead into Crazy Woman Creek.

Runoff is rapid on the Shingle soil and medium to rapid on the Cushman soil. The hazard of erosion is high on the Shingle soil. The hazard of water erosion is moderate to high on the Cushman soil, and if the cover is destroyed, the hazard of wind erosion is high.

Soils of this association are used for range and wildlife habitat. (Shingle soil in capability unit VIIe–14, dryland, and Shallow Loamy range site, 10 to 14 inch precipitation zone. Cushman soil in capability unit VIe–2, dryland, and Loamy range site, 10 to 14 inch precipitation zone)

Shingle-Kim association (SNc).—This association is about 30 percent Shingle loam, 10 to 30 percent slopes; about 25 percent Kim loam, 6 to 20 percent slopes; and about 20 percent Zigweid loam, 6 to 20 percent slopes. These soils are on upland ridges and alluvial fans. The Shingle soil is on upland ridges and the shoulders of ridges, the Kim soil is on the upper alluvial fans, and the Zigweid soil is on the lower alluvial fans. Some areas of this association are along intermittent drainageways.

Included with these soils in mapping are areas of Worf soils that make up about 15 percent of the acreage and areas of Stoneham soils that make up about 10 percent.

Runoff is rapid on the Shingle soil and medium to rapid on the Kim and Zigweid soils. The hazard of erosion is high on the Shingle soil and moderate to high on the Kim and Zigweid soils.

Soils of this association are used for range and wildlife habitat. (Shingle soil in capability unit VIIe–14, dryland, and Shallow Loamy range site, 10 to 14 inch precipitation zone. Kim and Zigweid soils in capability unit VIe–2, dryland, and Loamy range site, 10 to 14 inch precipitation zone)

Shingle-Kim association, valleys (SNd).—This association is about 50 percent Shingle loam, 10 to 30 percent slopes; about 20 percent Kim loam, 3 to 10 percent slopes; and about 15 percent Samsil silty clay, 10 to 30 percent slopes. The Shingle soil has the profile described as representative of the Shingle series. These soils occupy narrow bottoms of drainageways and sloping to steep hillsides that lead into drainageways. The Shingle and Samsil soils are on hillsides, and the Kim soil is in the narrow bottoms of drainageways and is subject to periodic overflow.

Included with these soils in mapping are areas of Worf soils that make up about 10 percent of the acreage and shale and siltstone outcrops that make up about 5 percent.

Runoff is rapid on the Shingle and Samsil soils and medium to rapid on the Kim soil. The hazard of erosion is high on the Shingle and Samsil soils and moderate to high on the Kim soil.

Soils of this association are used for range and wildlife habitat. (Shingle soil in capability unit VIIe–14, dryland, and Shallow Loamy range site, 10 to 14 inch precipitation zone. Kim soil in capability unit VIe–2, dry-

land, and Overflow range site, 10 to 14 inch precipitation zone. Samsil soil in capability unit VIIe–14, dryland, and Shallow Clayey range site, 10 to 14 inch precipitation zone)

Shingle-Tassel association (SNe).—This association is about 25 percent Shingle loam, 10 to 30 percent slopes; about 15 percent Shingle loam, 30 to 40 percent slopes; about 15 percent Tassel sandy loam, 15 to 30 percent slopes; about 10 percent Tassel sandy loam, 30 to 40 percent slopes; and about 15 percent Kim loam, 6 to 20 percent slopes. The Shingle and Tassel soils have profiles similar to the ones described as representative of the Shingle and Tassel series, except that they are underlain by bedrock at a depth of 8 to 10 inches. Also, they have stronger slopes. These soils are on ridges and in narrow valleys. The Shingle and Tassel soils are on ridge crests and the shoulders of ridges and on the upper hillsides, and the Kim soil is on the lower hillsides and in valleys. The largest acreage of this association is in the northeastern corner of the survey area, but a sizable acreage is also along Pine Ridge.

Included with these soils in mapping are areas of Schooner soils and other reddish-colored soils that make up as much as 15 percent of the acreage. Also included are areas of Worf and Schooner soils that make up about 5 percent of the acreage, very shallow soils similar to Shingle soils that make up about 5 percent, and exposed bedrock that makes up about 5 percent.

Runoff is rapid on the Shingle and Tassel soils and medium to rapid on the Kim soil. The hazard of erosion is high on the Shingle soils and moderate to high on the Kim soil. The hazard of water erosion is high on the Tassel soils, and if the cover is destroyed, the hazard of wind erosion is high.

Soils of this association are used for range and wildlife habitat. (Shingle and Tassel soils in capability unit VIIe–14, dryland. Shingle soil that has 10 to 30 percent slopes in Shallow Loamy range site, 10 to 14 inch precipitation zone; Shingle and Tassel soils that have 30 to 40 percent slopes in Very Shallow range site, 10 to 14 inch precipitation zone; and Tassel soil that has 15 to 30 percent slopes in Shallow Sandy range site, 10 to 14 inch precipitation zone. Kim soil in capability unit VIe–2, dryland, and Loamy range site, 10 to 14 inch precipitation zone)

Shingle-Worf association (SNf).—This association is is about 50 percent Shingle loam, 10 to 30 percent slopes, and about 30 percent Worf loam, 10 to 30 percent slopes. These soils occupy rounded upland ridges. The Shingle soil is on ridge crests and the shoulders of ridges, and the Worf soil is on rounded hillsides. Along the eastern flank of Pine Ridge in the northern part of the survey area, the Shingle and Worf soils are associated with reddish-colored soils similar to Southfork soils.

Included with these soils in mapping are areas of Cushman soils that make up about 15 percent of the acreage and areas of Samsil soils that make up about 5 percent.

Runoff is rapid, and the hazard of erosion is high.

Soils of this association are used for range and wildlife habitat. (Capability unit VIIe–14, dryland; Shallow Loamy range site, 10 to 14 inch precipitation zone.)

Shirk Series

The Shirk series consists of moderately steep, well-drained soils. These soils formed in residuum weathered from noncalcareous, platy shale on upland hillsides. Slopes range from 10 to 20 percent. Elevations range from 5,000 to 5,500 feet. The average annual precipitation is 12 to 13 inches, the average annual soil temperature is about 50° F., and the frost-free season is 95 to 100 days. The vegetation is western wheatgrass and big sagebrush.

In a representative profile the surface layer is grayish-brown, neutral clay loam about 3 inches thick. The subsoil is grayish-brown, neutral clay loam about 17 inches thick. The substratum is grayish-brown, neutral channery clay loam, about 6 inches thick, that is underlain by platy shale bedrock at a depth of about 26 inches.

Permeability is moderate, and the available water capacity is low to moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Shirk clay loam, in an area of Wormser-Shirk association, in the NE¼SE¼ sec. 9, T. 41 N., R. 81 W.

A1—0 to 3 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, crumb structure; soft, friable; many roots; neutral; clear, smooth boundary.

B21—3 to 14 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; weak, moderate to coarse, angular blocky structure; slightly hard, firm, slightly sticky and slightly plastic; few roots; neutral; clear, smooth boundary.

B22—14 to 20 inches, grayish-brown (2.5Y 5/2) clay loam, dark brown (10YR 4/3) moist; weak, fine to medium, angular blocky structure; very few faint clay films; slightly hard, firm, sticky and plastic; few roots; neutral; clear, smooth boundary.

C—20 to 26 inches, grayish-brown (10YR 5/2) channery clay loam, dark yellowish brown (10YR 3/4) moist; structureless; slightly hard, firm, sticky and plastic; many fine and few medium-size chips of platy shale, ½ to 1 inch in diameter; neutral; clear, smooth boundary.

R—26 inches +, fractured, noncalcareous, platy shale.

Depth to bedrock ranges from 20 to 40 inches. Content of coarse fragments ranges from 0 to 20 percent but typically is about 10 percent.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. It ranges from slightly acid to mildly alkaline. It is typically loam, but it ranges to channery loam or channery clay loam.

The B21 horizon ranges from 2.5Y to 10YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and ranges from 2 to 4 in chroma when dry and is 2 or 3 when moist. The B22 horizon ranges from 2.5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. The B2 horizon is neutral or mildly alkaline. It is loam, clay loam, or channery clay loam and has a content of clay that ranges from about 20 to 35 percent.

The C horizon ranges from 2.5Y to 10YR in hue. It is neutral or mildly alkaline.

Shirk soils are mapped in associations with Moret and Wormser soils.

Simmont Series

The Simmont series consists of moderately steep or steep, well-drained to excessively drained soils. These soils formed in residuum weathered from hard sandstone on

mountain flanks or hillsides. Slopes range from 15 to 40 percent. Elevations range from 5,500 to 6,500 feet. The average annual precipitation is 13 to 14 inches, the average annual soil temperature is about 45° F., and the frost-free season is 85 to 90 days. The vegetation is mainly ponderosa pine and balsamroot.

In a representative profile 1 inch of forest litter covers a surface layer of dark grayish-brown or brown, neutral sandy loam about 6 inches thick. The subsoil is dark yellowish-brown or yellowish-brown, neutral very cobbly sandy clay loam, about 16 inches thick, that is underlain by hard sandstone at a depth of about 22 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is 20 to 40 inches.

These soils are used for woodland and wildlife habitat.

Representative profile of Simmont sandy loam, in an area of Simmont-Rock outcrop complex, steep, near the center of sec. 3, T. 45 N., R. 83 W.

O1—1 inch to 0, organic mulch of forest litter.

A11—1 inch to 3 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, crumb structure: soft, very friable, slightly sticky; many roots; neutral; clear, smooth boundary.

A12—3 to 6 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; moderate, fine, crumb structure; soft, very friable, slightly sticky and slightly plastic; many roots; neutral; clear, smooth boundary.

B21t—6 to 12 inches, dark yellowish-brown (10YR 4/4) very cobbly sandy clay loam, dark brown (10YR 3/3) moist; moderate, fine and medium, angular blocky structure; thick discontinuous clay films; slightly hard, friable, sticky and plastic; 50 percent 3- to 10-inch, angular, sandstone fragments; many roots; neutral; clear, smooth boundary.

B22t—12 to 22 inches, yellowish-brown (10YR 5/4) very cobbly sandy clay loam, dark yellowish brown (10YR 4/4) moist; weak, fine, angular blocky structure; thin discontinuous clay films; slightly hard, friable, sticky and plastic; 50 percent 3- to 10-inch angular sandstone fragments; few roots; neutral; clear, smooth boundary.

R—22 inches, hard, noncalcareous sandstone.

Depth to bedrock ranges from 20 to 40 inches, and thickness of the solum ranges from 20 to 30 inches. Content of coarse fragments in the solum ranges from 35 to 80 percent. The fragments are mainly sandstone and are 3 to 10 inches in diameter. These soils are neutral or mildly alkaline throughout the profile.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 3 to 5 in value when dry and 2 to 3 when moist, and is 2 or 3 in chroma when dry or moist.

The B21t horizon ranges from 2.5Y to 7.5YR in hue, ranges from 3 to 5 in value when dry and is 2 or 3 when moist, and is 3 or 4 in chroma when dry or moist. The B22t horizon ranges from 2.5Y to 7.5YR in hue, ranges from 4 to 6 in value when dry and is 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist.

The C horizon, when present, ranges from 2.5Y to 7.5YR in hue.

Simmont-Rock outcrop complex, steep (SOE).—This complex is about 50 percent Simmont sandy loam, 15 to 40 percent slopes, and about 35 percent barren Rock outcrop. The Simmont soil has the profile described as representative of the Simmont series. The Simmont soil and barren Rock outcrop are intermingled in an intricate and complex pattern.

Included with these soils in mapping are areas of soils similar to this Simmont soil that make up about 15 percent of the acreage. The soils differ from this Simmont soil in that bedrock is at a depth of less than 20 inches. Also included are many vertical canyons and rock cliffs.

Runoff is rapid, and the hazard of erosion is high.

Soils of this complex are used for woodland and wildlife habitat. The dominant tree species on the Simmont soil is ponderosa pine. The areas are not accessible, and woodland production is not practical. The Simmont part of this complex is in woodland group 4. (Capability unit VIIs–9, dryland; not in a range site)

Slipman Series

The Slipman series consists of moderately steep, well-drained soils. These soils formed in alluvium derived from sandstone. These soils are on mountain hillsides. Slopes range from 10 to 20 percent. Elevations range from 7,500 to 8,000 feet. The average annual precipitation is 15 to 16 inches, and the average annual soil temperature is about 41° F. The frost-free season is 70 to 75 days, although frost can occur during any month. The vegetation is ponderosa pine and Idaho fescue.

In a representative profile the surface layer is grayish-brown or brown, slightly acid sandy loam about 16 inches thick. The subsurface layer is pale-brown or light-brown, slightly acid or neutral loamy fine sand about 11 inches thick that has many, fine, dark-brown, clayey seams and nodules in the lower 5 inches. The subsoil is brown, neutral sandy clay loam, about 25 inches thick, that is about 25 percent sandstone fragments in the lower 15 inches. Hard sandstone bedrock is at a depth of about 52 inches.

Permeability is moderately rapid, and the available water capacity is moderate to high. The effective rooting depth is 50 to 60 inches.

These soils are used for woodland and wildlife habitat.

Representative profile of Slipman sandy loam, in an area of Passcreek-Sublette-Slipman association, in the SW¼SW¼ sec. 25, T. 45 N., R. 84 W.

A11—0 to 7 inches, grayish-brown (10YR 5/2) sandy loam, very dark brown (10YR 2/2) moist; weak to moderate, fine, crumb structure; soft, very friable; many roots; slightly acid; clear, wavy boundary.

A12—7 to 16 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; massive or weak, coarse, crumb structure; slightly hard, loose; few roots; slightly acid; clear, wavy boundary.

A2—16 to 22 inches, pale-brown (10YR 6/3) loamy fine sand, dark brown (10YR 4/3) moist; single grained; soft, friable; few roots; slightly acid; clear, wavy boundary.

AB—22 to 27 inches, light-brown (7.5YR 6/4) loamy fine sand, brown (7.5YR 5/4) moist; weak, coarse, angular blocky structure; many, fine, dark-brown, clayey seams and nodules of material from the B21t horizon in a matrix of material from the A2 horizon; soft, very friable; few roots; neutral; clear, wavy boundary.

B21t—27 to 37 inches, brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 4/4) moist; weak, medium, angular blocky structure; thin discontinuous clay spots and films and thick discontinuous clay films on cleavage planes; slightly hard, very friable; slightly sticky and slightly plastic; neutral; gradual, wavy boundary.

B22t—37 to 52 inches, brown (7.5YR 5/3) sandy clay loam, dark brown (7.5YR 4/3) moist; weak, medium, angular blocky structure; thick clay films on peds; 25 percent sandstone fragments; slightly hard, friable, sticky and plastic; neutral; gradual, wavy boundary.

R—52 inches, hard, noncalcareous, sandstone bedrock.

Depth to bedrock in most places ranges from 50 to 60 inches. These soils generally are noncalcareous to bedrock, but in places they are slightly calcareous below a depth of 40 inches. Thickness of the solum ranges from 30 to 60 inches. Content of coarse fragments increases as depth increases and is more than 20 percent in the lower part of the solum.

The A1 horizon ranges from 10YR to 7.5YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist.

The A2 horizon ranges from 10YR to 7.5YR in hue, from 5 to 7 in value when dry and from 4 to 6 when moist, and from 2 to 4 in chroma when dry or moist.

The B2t horizon ranges from about 20 to 35 percent in content of clay, but typically it is sandy clay loam that is 20 to 26 percent clay. It ranges from 2.5YR to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 3 to 6 in chroma when dry and is 3 or 4 when moist.

Slipman soils are mapped in an association with Passcreek and Sublette soils.

Slocum Series

The Slocum series consists of gently sloping to sloping, somewhat poorly drained soils. These soils formed in alluvium derived from limestone. They are on alluvial fans in the mountains. Slopes range from 3 to 10 percent. Elevations range from 7,600 to 9,500 feet. The average annual precipitation is 18 to 19 inches, and the average annual soil temperature is about 40° F. The frost-free season is 60 to 65 days, although frost can occur during any month. The vegetation is mountain sedges and grasses.

In a representative profile the surface layer is dark-gray, mildly alkaline silt loam or clay loam about 12 inches thick. The underlying layer is light yellowish-brown or light olive-gray, neutral or mildly alkaline clay loam that reaches to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more. These soils have a seasonal high water table between depths of 2 and 3 feet.

These soils are used for range and wildlife habitat.

Representative profile of Slocum silt loam, in an area of Auzqui-Slocum association, in the NW¼NE¼ sec. 4, T. 46 N., R. 85 W.

A11—0 to 5 inches, dark-gray (10YR 4/1) silt loam, very dark gray (10YR 3/1) moist; moderate, fine, crumb structure; slightly hard, firm, slightly sticky and slightly plastic; many roots; mildly alkaline; clear, smooth boundary.

A12—5 to 12 inches, dark-gray (10YR 4/1) clay loam, very dark grayish brown (10YR 3/2) moist; weak, coarse, angular blocky structure parting to strong, fine, crumb; slightly hard, very firm, very sticky and very plastic; many roots; mildly alkaline; clear, smooth boundary.

C1g—12 to 30 inches, light yellowish-brown (2.5Y 6/3) clay loam, light olive brown (2.5Y 5/3) moist; massive; few limestone stone-size fragments make up 5 percent of mass; slightly hard, friable, sticky and plastic; few roots to a depth of 18 inches; slight effervescence in pockets and seams of noncalcareous matrix; neutral; gradual, wavy boundary.

C2g—30 to 60 inches, light olive-gray (5Y 6/2) clay loam, olive gray (5Y 5/2) moist; mottled with spots and threads of material from the C1g horizon; structureless; slightly hard, firm, sticky and slightly plastic; slight effervescence; few lime nodules; mildly alkaline.

Content of coarse fragments ranges from 5 to 25 percent but typically is about 5 percent in the lower part of the profile. These soils are neutral or mildly alkaline throughout the profile.

The A horizon ranges from 2.5Y to 10YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and ranges from 1 to 3 in chroma when dry and is 1 or 2 when moist.

The Cg horizon ranges from 5Y to 10YR in hue, is 5 or 6 in value when dry and ranges from 4 to 6 when moist, and ranges from 2 to 4 in chroma when dry or moist. It is silt loam, clay loam, or silty clay loam, and the content of clay ranges from 18 to 35 percent.

Slocum soils are mapped in an association with Auzqui soils.

Southfork Series

The Southfork series consists of moderately steep or steep, well-drained to somewhat excessively drained soils. These soils formed in residuum weathered from reddish-colored sandstone on upland ridges. Slopes range from 10 to 30 percent. Elevations range from 4,500 to 5,200 feet. The average annual precipitation is 10 to 12 inches, the average annual soil temperature is about 52° F., and the frost-free season is 105 to 120 days. The vegetation is blue grama and Sandberg bluegrass.

In a representative profile the surface layer is reddish-brown, neutral loamy sand about 4 inches thick. The upper part of the subsoil is reddish-brown, neutral coarse sandy loam about 8 inches thick, and the lower part is pink, mildly alkaline very coarse sand about 3 inches thick. Next is reddish-gray sandstone at a depth of about 15 inches.

Permeability is moderately rapid, and the available water capacity is low. The effective rooting depth is 10 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Southfork loamy sand, in an area of Pugsley-Southfork complex, hilly, in the SW¼NW¼ sec. 36, T. 44 N., R. 81 W.

A1—0 to 4 inches, reddish-brown (5YR 5/3) loamy sand, reddish brown (5YR 4/3) moist; weak, fine, granular structure; loose; neutral; clear, smooth boundary.

B2t—4 to 12 inches, reddish-brown (2.5YR 5/3) coarse sandy loam, reddish brown (2.5YR 4/3) moist; moderate, very coarse, prismatic structure parting to moderate, coarse, subangular blocky; hard, very friable; peds are extremely hard, firm; thin glossy patches on ped faces and thin glossy coatings on sand grains; neutral; gradual, wavy boundary.

B3—12 to 15 inches, pink (5YR 7/3) very coarse sand, reddish brown (5YR 5/3) moist; weak, very coarse, prismatic structure parting to weak, coarse, subangular blocky; hard, loose; peds are very hard; slight effervescence; mildly alkaline; gradual, wavy boundary.

C—15 inches, reddish-gray, noncalcareous or very weakly calcareous sandstone; can be penetrated with difficulty with a spade when dry.

Depth to bedrock, depth to calcareous material, and thickness of the solum range from 10 to 20 inches. Content of coarse fragments ranges from 0 to 15 percent. The lower part of the solum and the C horizon generally are slightly calcareous and, in places, contain a few concretions or coatings of secondary calcium carbonate. These soils are neutral or mildly alkaline in reaction.

The A1 horizon ranges from 7.5YR to 5YR in hue, is 5 or 6 in value when dry and 3 or 4 when moist, and ranges from 2 to 4 in chroma when dry or moist. Where the A1 horizon has a color value as dark as 5 when dry and 3 when moist, it is less than 4 inches thick. In most places the primary structure is granular, but in some places the horizon is single grained. This horizon ranges from loose to slightly hard when dry.

The B2t horizon ranges from 5YR to 2.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 3 or 4 in chroma when dry or moist. It ranges from neutral to

mildly alkaline. In most places the primary structure is very coarse and prismatic, but in some places it is subangular blocky. It is typically sandy loam, but the content of clay ranges from about 10 to 18 percent.

Southfork soils are mapped in an association with Pugsley soils.

Spearfish Series

The Spearfish series consists of moderately steep or steep, well-drained to excessively drained soils. These soils formed in residuum weathered from reddish-colored sandstone and siltstone on upland ridges. Slopes range from 10 to 40 percent. Elevations range from 5,000 to 6,000 feet. The average annual precipitation is 11 to 12 inches, the average annual soil temperature is about 50° F., and the frost-free season is 100 to 105 days. The vegetation is bluebunch wheatgrass and mountain-mahogany.

In a representative profile the surface layer is reddish-brown, moderately alkaline very fine sandy loam about 3 inches thick. The underlying layer is red, moderately alkaline and strongly alkaline very fine sandy loam and channery loam, about 14 inches thick, that is underlain by soft, red siltstone and sandstone at a depth of about 17 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is 8 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Spearfish very fine sandy loam, 10 to 30 percent slopes, in an area of Spearfish-Shale outcrop complex, steep, in the SE¼SE¼ sec. 26, T. 43 N., R. 84 W.

A1—0 to 3 inches, reddish-brown (2.5YR 5/4) very fine sandy loam, dark reddish brown (2.5YR 3/4) moist; moderate, fine and medium, crumb structure; soft, very friable, slightly plastic; many roots; strong effervescence; moderately alkaline; clear, smooth boundary.

AC—3 to 12 inches, red (2.5YR 4/6) very fine sandy loam, dark red (2.5YR 3/6) moist; weak, coarse, crumb structure; soft, friable, slightly sticky and slightly plastic; many roots; violent effervescence; moderately alkaline; clear, smooth boundary.

C1—12 to 17 inches, red (2.5YR 5/6) channery loam, red (2.5YR 4/6) moist; structureless; many, ¼- to 3-inch, angular, platy fragments of weathered bedrock; soft, friable, slightly sticky; violent effervescence; strongly alkaline; clear, wavy boundary.

C2—17 inches, soft, calcareous, red siltstone and very fine grained sandstone.

Depth to bedrock ranges from 8 to 20 inches. These soils are moderately alkaline or strongly alkaline throughout. The texture is very fine sandy loam, loam, or light clay loam, and the clay content ranges from 16 to 28 percent.

The A1 horizon ranges from 5YR to 10R in hue, is 5 or 6 in value when dry and 3 or 4 when moist, and ranges from 4 to 6 in chroma when dry or moist. Content of coarse, weathered siltstone and sandstone fragments ranges from 0 to 20 percent in the A1 and AC horizons.

The AC and C horizons range from 5YR to 10R in hue, from 4 to 6 in value when dry and from 3 to 5 when moist, and from 4 to 6 in chroma when dry or moist.

Spearfish-Shale outcrop complex, steep (SPE).—This complex is about 30 percent Spearfish very fine sandy loam, 10 to 30 percent slopes; about 20 percent Spearfish very fine sandy loam, 30 to 40 percent slopes; and about 30 percent Shale outcrop. The less sloping Spearfish soil has the profile described as representative of the Spearfish series. The more sloping Spearfish soil has a profile similar to the one described as representative of the series, except that depth to bedrock is 8 to 10 inches. In some places there is a thin, gravelly mantle on the surface of the Spearfish soils. These soils occupy upland ridges and steep drainageways. The Spearfish soils and Shale outcrop are intermingled in a complex pattern. This complex is in the Red Wall area and runs the full length of the survey area from north to south.

Included with these soils in mapping are areas of very shallow soils similar to the Spearfish soils that make up about 10 percent of the acreage and areas of Connerton soils that make up about 5 percent.

Runoff is rapid, and the hazard of water erosion is high. If the cover is destroyed, the hazard of wind erosion is high.

Soils of this complex are used for range and wildlife habitat. (Capability unit VIIe-14, dryland. Spearfish very fine sandy loam, 10 to 30 percent slopes, in Shallow Loamy range site, 10 to 14 inch precipitation zone; Spearfish very fine sandy loam, 30 to 40 percent slopes, in Very Shallow range site, 10 to 14 inch precipitation zone; and Shale outcrop not in a range site)

Splitro Series

The Splitro series consists of sloping to steep, well-drained soils. These soils formed in residuum weathered from reddish-colored sandstone on mountain ridges. Slopes range from 6 to 30 percent. Elevations range from 8,000 to 9,500 feet. The average annual precipitation is 17 to 18 inches, and the average annual soil temperature is about 40° F. The frost-free season is 60 to 65 days, although frost can occur during any month. The vegetation is mountain grasses and sedges dominated by Idaho fescue.

In a representative profile these soils are brown, neutral sandy loam or fine sandy loam that is underlain by hard sandstone at a depth of about 16 inches.

Permeability is moderately rapid, and the available water capacity is low. The effective rooting depth is 10 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Splitro sandy loam, in an area of Poker-Bachus-Splitro association, in the NE¼NE¼ sec. 30, T. 45 N., R. 85 W.

A1—0 to 8 inches, brown (7.5YR 5/3) sandy loam, dark brown (7.5YR 3/3) moist; moderate, fine, crumb or granular structure; soft, very friable; scattered sandstone rock on the surface; neutral; clear, smooth boundary.

B2—8 to 16 inches, brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 4/4) moist; moderate, coarse, subangular blocky structure; slightly hard, very friable; 5 percent sandstone fragments; neutral; abrupt, smooth boundary.

R—16 inches, hard, quartzitic sandstone.

Depth to bedrock ranges from 10 to 20 inches. Content of coarse fragments ranges from 5 to 25 percent. These soils range from slightly acid to mildly alkaline throughout the profile.

The A1 horizon ranges from 10YR to 7.5YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. In most places it has crumb or granular structure, but in some places it has subangular blocky structure. This horizon is soft or slightly hard when dry.

The B2 horizon ranges from 10YR to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 3 to 5 in chroma when dry or moist. In places the B2 horizon does not occur. In most places it has subangular blocky structure, but in some places it has prismatic structure.

Splitro soils are mapped in an association with Bachus and Poker soils.

Starley Series

The Starley series consists of moderately steep or steep, well-drained to excessively drained soils. These soils formed in residuum weathered from limestone on ridges and hillsides in the mountains. Slopes range from 10 to 40 percent. Elevations range from 7,500 to 9,000 feet. The average annual precipitation is 15 to 19 inches, and the average annual soil temperature is about 40° F. The frost-free season is 60 to 65 days, although frost can occur during any month. The vegetation is big sagebrush and Idaho fescue.

In a representative profile the surface layer is dark grayish-brown, moderately alkaline gravelly loam about 6 inches thick. The underlying layer is pale-brown, moderately alkaline cobbly clay loam, about 10 inches thick, that is underlain by hard, fractured limestone at a depth of about 16 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is 8 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Starley gravelly loam in the NW¼NW¼ sec. 27, T. 45 N., R. 84 W.

A1—0 to 6 inches, dark grayish-brown (10YR 4/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, crumb structure; 25 to 35 percent limestone fragments, 3 to 10 inches in diameter; soft, friable, slightly sticky and slightly plastic; many roots; strong effervescence; moderately alkaline; clear, smooth boundary.

C—6 to 16 inches, pale-brown (10YR 6/3) cobbly clay loam, brown (10YR 5/3) moist; structureless; 50 percent limestone fragments, 3 to 10 inches in diameter; slightly hard, friable, sticky and plastic; few roots to depth of 10 inches, very few roots between depths of 10 and 16 inches; violent effervescence; moderately alkaline; gradual, wavy boundary.

R—16 inches, hard fractured limestone.

Depth to bedrock ranges from 8 to 20 inches. Content of coarse fragments ranges from 25 to 50 percent in the A1 horizon and from 35 to more than 50 percent in the C horizon.

The A1 horizon ranges from 10YR to 7.5YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. It ranges from mildly alkaline to strongly alkaline.

The C horizon ranges from 10YR to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It is moderately alkaline or strongly alkaline.

Starley-Rock outcrop complex, steep (SRE).—This complex is about 30 percent Starley gravelly loam, 10 to 30 percent slopes; about 30 percent Starley gravelly loam, 30 to 40 percent slopes; and about 25 percent Rock outcrop. The less sloping Starley soil has the profile described as representative of the Starley series. The more sloping Starley soil has a profile similar to the one described as representative of the Starley series, except that bedrock is at a depth of 8 to 10 inches. These soils occupy ridges and hillsides in the mountains. The Starley soils and Rock outcrop are intermingled in an intricate pattern. The Rock outcrop is limestone and generally occurs as ledges; areas of Starley soils are between the ledges. In some places the ledges are not continuous and are surrounded by Starley soils.

Included with these soils in mapping are areas of Nathrop soils that make up about 10 percent of the acreage and areas of Woosley soils that make up about 5 percent.

Runoff is rapid, and the hazard of erosion is high.

Soils of this complex are used for range and wildlife habitat. (Capability unit VIIe-14, dryland. Starley gravelly loam, 10 to 30 percent slopes, in Shallow Loamy range site, 15 to 19 inch precipitation zone; Starley gravelly loam, 30 to 40 percent slopes, in Very Shallow range site, 15 to 19 inch precipitation zone; Rock outcrop not in a range site)

Stoneham Series

The Stoneham series consists of nearly level to moderately steep, well-drained soils. These soils formed in alluvium derived from sandstone and siltstone. They are on alluvial fans. Slopes range from 0 to 20 percent. Elevations range from 4,500 to 5,200 feet. The average annual precipitation is 10 to 13 inches, the average annual soil temperature is about 50° F., and the frost-free season is 105 to 120 days. The vegetation is western wheatgrass, blue grama, and big sagebrush.

In a representative profile the surface layer is light brownish-gray or brown, neutral sandy loam about 4 inches thick. The subsoil is dark yellowish-brown or light olive-brown, mildly alkaline clay loam about 10 inches thick. The substratum is light yellowish-brown, moderately alkaline or strongly alkaline clay loam and loam that reaches to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more.

These soils are used for range and for irrigated hay, pasture, and small grain.

Representative profile of Stoneham sandy loam, in an area of Stoneham-Absted complex, in the NE¼NE¼ sec. 17, T. 45 N., R. 79 W.

A11—0 to 2 inches, light brownish-gray (10YR 6/2) sandy loam, dark brown (10YR 3/3) moist; weak, medium, crumb structure; loose dry and moist; neutral; clear, smooth boundary.

A12—2 to 4 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; weak, fine, crumb structure; soft, very friable; many roots; neutral; abrupt, smooth boundary.

B2t—4 to 9 inches, dark yellowish-brown (10YR 4/4) clay loam, dark yellowish brown (10YR 3/4) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; thick continuous clay films; slightly hard, firm, sticky and slightly plastic; few roots; mildly alkaline; clear, wavy boundary.

B3ca—9 to 14 inches, light olive-brown (2.5Y 5/4) clay loam, olive brown (2.5Y 4/4) moist; weak, medium, subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; thin discontinuous clay films on vertical surfaces; strong effervescence; mildly alkaline; gradual, smooth boundary.

C1ca—14 to 30 inches, light yellowish-brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; structureless; slightly hard, friable, slightly sticky and slightly plastic; many fine specks and threads of calcium

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carbonate; violent effervescence; moderately alkaline; clear, smooth boundary.

C2ca—30 to 60 inches, light yellowish-brown (2.5Y 6/4) loam, light olive brown (2.5Y 5/4) moist; structureless; soft, very friable, slightly sticky and slightly plastic; many fine threads of calcium carbonate; violent effervescence; strongly alkaline.

Depth to calcareous material ranges from 6 to 12 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent.

The A1 horizon ranges from 10YR to 2.5YR in hue, is 5 or 6 in value when dry and ranges from 3 to 5 when moist, and is 2 or 3 in chroma when dry or moist. The A and B2t horizons are neutral or mildly alkaline.

The B2t horizon ranges from 2.5Y to 7.5YR in hue, ranges from 4 to 6 in value when dry and is 3 or 4 when moist, and ranges from 2 to 4 in chroma when dry or moist. It is generally loam or clay loam, and the clay content ranges from 18 to 35 percent.

The C horizon ranges from 2.5Y to 10YR in hue. It is moderately alkaline or strongly alkaline. The C horizon in some places contains sand and gravel below a depth of 50 inches.

Stoneham loam, 0 to 3 percent slopes (SsA).—This soil is on alluvial fans, mainly in stream valleys above the flood plains. This soil has a profile similar to the one described as representative of the series, except that the surface layer is brown loam about 6 inches thick. In some mapped areas it has a surface layer of light clay loam.

Included with this soil in mapping are areas of Fort Collins and Zigweid soils.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for irrigated hay, pasture, and small grain and for dryland spring wheat and hay. (Capability units IVe–2, dryland, and IIe–2, irrigated; Loamy range site, 10 to 14 inch precipitation zone)

Stoneham loam, 3 to 6 percent slopes (SsB).—This soil is on alluvial fans on the sides of valleys. It has a profile similar to the one described as representative of the series, except that the surface layer is brown loam about 6 inches thick.

Included with this soil in mapping are areas of Fort Collins, Kim, and Zigweid soils.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for irrigated hay, pasture, and small grain and for dryland spring wheat and hay. (Capability units IVe–2, dryland, and IIIe–2, irrigated; Loamy range site, 10 to 14 inch precipitation zone)

Stoneham loam, 6 to 10 percent slopes (SsC).—This soil is on alluvial fans in the upper valleys at the base of uplands, mainly along the Middle Fork of Powder River below Kaycee. It has a profile similar to the one described as representative of the series, except that the surface layer is brown loam about 6 inches thick.

Included with this soil in mapping are areas of Fort Collins, Kim, and Zigweid soils.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This soil is used for irrigated hay, small grain, and pasture and for range. (Capability units VIe–2, dryland, and IVe–2, irrigated; Loamy range site, 10 to 14 inch precipitation zone)

Stoneham-Absted complex (STa).—This complex is about 60 percent Stoneham sandy loam, 0 to 3 percent slopes, and about 20 percent Absted very fine sandy loam, 0 to 3 percent slopes. The Stoneham soil has the profile described as representative of the Stoneham series. These soils occupy alluvial fans. The areas are generally long, of various widths, and parellel to drainageways. The Stoneham and Absted soils are intermingled in a complex pattern in most places. In some areas the Stoneham soil is on the main part of the landscape, and the Absted soil is around the outer edges.

Included with these soils in mapping are areas of Bone soils that make up about 10 percent of the acreage and areas of Wyarno soils that make up about 10 percent.

Runoff is slow, and the hazard of erosion is slight. If the cover is destroyed, the hazard of wind erosion is high.

Soils of this complex are used for range and wildlife habitat. (Capability unit IVe–2, dryland; Loamy range site, 10 to 14 inch precipitation zone)

Stoneham-Ascalon association (STb).—This association is about 50 percent Stoneham sandy loam, 6 to 10 percent slopes, and about 30 percent Ascalon fine sandy loam, 3 to 10 percent slopes. These soils occupy alluvial fans at the base of uplands. Sizable acreages are in the southeastern part of the survey area. The Stoneham soil is on alluvial fans, and the Ascalon soil is on alluvial fans, generally on the lower parts of the landscape.

Included with these soils in mapping in some places are areas of Cushman soils on rolling uplands that make up 15 percent or more of the acreage. Normally inclusions are areas of Cushman soils that make up about 10 percent, areas of Julesberg soils that make up about 5 percent, and areas of Worf soils that make up about 5 percent.

Runoff is medium on the Stoneham soil and slow to medium on the Ascalon soil. The hazard of water erosion is moderate on the Stoneham soil and slight to moderate on the Ascalon soil, and if the cover is destroyed, the hazard of wind erosion is high.

Soils of this association are used for range and wildlife habitat. (Stoneham soil in capability unit VIe–2, dryland; Ascalon soil in capability unit IVe–5, dryland. Both soils in Loamy range site, 10 to 14 inch precipitation zone)

Stoneham-Cragola association (STc).—This association is about 40 percent Stoneham sandy loam, 6 to 10 percent slopes; about 25 percent Cragola very gravelly loam, 10 to 30 percent slopes; and about 20 percent Wolf loam, 3 to 15 percent slopes. These soils are mainly on old high terraces adjacent to the North Fork of Powder River, above the town of Kaycee. They also are on alluvial fans and uplands. The Stoneham soil is on alluvial fans, the Cragola soil is on uplands, and the Wolf soil is on high terraces.

Included with these soils in mapping are areas of Kim soils that make up about 10 percent of the acreage and steep-sided drainageways that make up about 5 percent.

Runoff is medium on the Stoneham soil, rapid on the Cragola soil, and medium to rapid on the Wolf soil. The hazard of water erosion is moderate, and if the cover is destroyed, the hazard of wind erosion is high on the Stoneham soil. The hazard of erosion is high on the Cragola soil and moderate to high on the Wolf soil.

Soils of this association are used for range and wildlife habitat and, in some places, as a source of sand and gravel. (Stoneham and Wolf soils in capability unit VIe–2, dryland, and Loamy range site, 10 to 14 inch precipitation zone. Cragola soil in capability unit VIIe–14, dryland, and Shallow Clayey range site, 10 to 14 inch precipitation zone)

Stoneham-Cushman association (STd).—This association is about 50 percent Stoneham sandy loam, 6 to 10 percent slopes, and about 30 percent Cushman fine sandy loam, 6 to 20 percent slopes. These soils occupy uplands and sides of valleys. The Stoneham soil is on alluvial fans on sides of valleys, below uplands that are occupied by the Cushman soil. Sizable areas of this association are in the southeastern part of the survey area.

Included with these soils in mapping are areas of Zigweid soils that make up about 10 percent of the acreage. Also included are areas of Shingle soils that make up about 5 percent and areas of Worf soils that make up about 5 percent.

Runoff is medium on the Stoneham soil and medium to rapid on the Cushman soil. The hazard of water erosion is moderate on the Stoneham soil and moderate to high on the Cushman soil, and if the cover is destroyed, the hazard of wind erosion is high.

Soils of this association are used for range and wildlife habitat. (Capability unit VIe-2, dryland; Loamy range site, 10 to 14 inch precipitation zone)

Stoneham-Fort Collins association (STe).—This association is about 50 percent Stoneham sandy loam, 0 to 3 percent slopes, and about 30 percent Fort Collins fine sandy loam, 0 to 3 percent slopes. These soils are on alluvial fans. They are generally bounded on at least two sides by drainageways and occur as long, undulating areas of varying widths. The Stoneham soil is on slightly rounded surfaces, and the Fort Collins soil is in nearly level areas. In places these soils are intermingled on planed landscapes.

Included with these soils in mapping are areas of Zigweid soils that make up about 10 percent of the acreage. Also included are areas of Ulm soils that make up about 5 percent and areas of Wyarno soils that make up about 5 percent.

Runoff is slow, and the hazard of erosion is slight. If the soil is left bare, the hazard of wind erosion is high.

Soils of this association are used for range and wildlife habitat. (Capability unit IVe-2, dryland; Loamy range site, 10 to 14 inch precipitation zone)

Stoneham-Kim association (STf).—This association is about 40 percent Stoneham sandy loam, 6 to 20 percent slopes; about 20 percent Kim loam, 6 to 20 percent slopes; and about 20 percent Shingle loam, 10 to 30 percent slopes. These soils are on rounded ridges and alluvial fans. The Stoneham soil is on the lower alluvial fans, the Kim soil is on the upper alluvial fans and the Shingle soil is on rounded ridges and the shoulders of ridges.

Included with these soils in mapping are areas of Worf soils that make up about 15 percent of the acreage and areas of Zigweid soils that make up about 5 percent.

Runoff is medium to rapid on the Stoneham and Kim soils and rapid on Shingle soils. The hazard of erosion is moderate to high on the Kim soil and high on the Shingle soil. The hazard of water erosion is moderate to high on the Stoneham soil, and if the cover is destroyed, the hazard of wind erosion is high.

Soils of this association are used for range and wildlife habitat. (Stoneham and Kim soils in capability unit VIe-2, dryland, and Loamy range site, 10 to 14 inch precipitation zone. Shingle soil in capability unit VIIe-14, dryland, and Shallow Loamy range site, 10 to 14 inch precipitation zone)

Stoneham-Zigweid association (STg).—This association is about 50 percent Stoneham sandy loam, 0 to 6 percent slopes, and about 30 percent Zigweid loam, 0 to 6 percent slopes. These soils are on alluvial fans that form long, undulating areas of varying widths. The Stoneham soils are nearly level, and the Zigweid soils are undulating. Areas of this association occur throughout the eastern third of the survey area.

Included with these soils in mapping are areas of Kim soils that make up about 15 percent of the acreage and areas of Wyarno soils that make up about 5 percent.

Runoff is slow to medium, and the hazard of erosion is slight to moderate. If the cover is destroyed, the hazard of wind erosion is high on the Stoneham soil.

Soils of this association are used for range and wildlife habitat. (Capability unit IVe-2, dryland; Loamy range site, 10 to 14 inch precipitation zone)

Stubbs Series

The Stubbs series consists of sloping or moderately steep, well-drained soils. These soils formed in residuum weathered from calcareous shale on hillsides in the mountains. Slopes range from 6 to 20 percent. Elevations range from 8,000 to 9,000 feet. The average annual precipitation is 18 to 19 inches, and the average annual soil temperature is about 40° F. The frost-free season is 60 to 65 days, although frost can occur during any month. The vegetation is Idaho fescue, Columbia needlegrass, and silvery lupine.

In a representative profile the surface layer is very dark grayish-brown, neutral loam about 14 inches thick. The subsoil is very dark grayish-brown and dark yellowish-brown, neutral and moderately alkaline clay loam about 10 inches thick. The substratum is dark yellowish-brown, moderately alkaline clay loam, about 8 inches thick, that is underlain by soft, calcareous shale at a depth of about 32 inches.

Permeability and the available water capacity are moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Stubbs loam, in an area of Stubbs-Turk association, in the NW¼NW¼ sec. 19, T. 44 N., R. 85 W.

A11—0 to 5 inches, very dark grayish-brown (10YR 3/2) loam, black (10YR 2/1) moist; strong, fine, crumb structure; soft, very friable; many roots; neutral; clear, smooth boundary.

A3—5 to 14 inches, very dark grayish-brown (10YR 3/2) loam, black (10YR 2/1) moist; moderate, fine, prismatic structure parting to moderate, medium, angular blocky and strong, fine, angular blocky; organic stains on all ped faces; slightly hard, friable, slightly sticky and slightly plastic; many roots; neutral; clear, smooth boundary.

B21t—14 to 20 inches, very dark grayish-brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) moist; moderate, medium, prismatic structure parting to moderate, fine and medium, angular blocky; thick nearly continuous clay films on all ped surfaces; slightly hard, friable, slightly sticky and slightly plastic; few roots; neutral; clear, wavy boundary.

B22t—20 to 24 inches, dark yellowish-brown (10YR 4/4) clay loam, dark brown (10YR 4/3) moist; weak, medium, angular blocky structure; thin patchy clay films, mainly on vertical ped faces; soft, friable, slightly sticky and slightly plastic; very few roots; violent

effervescence; moderately alkaline; clear, wavy boundary.

C1—24 to 32 inches, dark-brown (10YR 4/3) clay loam, dark brown (10YR 4/3) moist; structureless; few limestone fragments throughout the horizon; loose, firm, sticky; very few roots; violent effervescence; moderately alkaline; clear, wavy boundary.

C2—32 inches, olive to brown, calcareous, soft shale.

Depth to bedrock ranges from 20 to 40 inches, depth to calcareous material ranges from 15 to 30 inches, and thickness of the solum ranges from 18 to 34 inches. These soils do not have a consistent horizon of secondary calcium carbonate accumulation. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 10 percent.

The A horizon ranges from 2.5Y to 10YR in hue, is 3 or 4 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry and 1 or 2 when moist. It ranges from slightly acid to mildly alkaline.

The B21t horizon ranges from 2.5Y to 7.5YR in hue, ranges from 3 to 5 in value when dry and is 2 or 3 when moist, and ranges from 2 to 4 in chroma when dry and is 2 or 3 when moist. The B22t horizon ranges from 2.5Y to 7.5YR in hue, ranges from 4 to 6 in value when dry and is 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. The B2 horizon is neutral or moderately alkaline. It is generally loam or clay loam, and the content of clay ranges from 18 to 35 percent.

The C horizon ranges from 2.5Y to 10YR in hue. It is moderately alkaline or strongly alkaline. In some places the C horizon is lacking.

Stubbs-Turk association (SU).—This association is about 40 percent Stubbs loam, 6 to 20 percent slopes, and about 30 percent Turk silty clay loam, 6 to 20 percent slopes. The Stubbs soil has the profile described as representative of the Stubbs series. These soils are on rounded knobs and ridges and hillsides in the mountains. The Stubbs soil is on the lower hillsides, and the Turk soil is on hillsides, mainly above the Stubbs soil.

Included with these soils in mapping are areas of soils similar to this Stubbs soil that make up 15 to 20 percent of the acreage. These soils differ from this Stubbs soil in that they are noncalcareous to bedrock. Also included are areas of noncalcareous Stubbs soils that make up about 15 percent of the acreage, areas of Lymanson soils that make up about 10 percent, and areas of soils similar to this Turk soil that make up 5 percent. These soils differ from the Turk soil in that they are more than 40 inches deep to bedrock.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

Soils of this association are used for range and wildlife habitat. (Stubbs soil in capability unit VIe–2, dryland, and Loamy range site, 15 to 19 inch precipitation zone. Turk soil in capability unit VIe–1, dryland, Clayey range site, 15 to 19 inch precipitation zone)

Sublette Series

The Sublette series consists of sloping or moderately steep, well-drained soils. These soils formed in alluvium derived from sandstone. They are on alluvial fans and foot slopes in the mountains. Slopes range from 6 to 20 percent. Elevations range from 6,800 to 8,000 feet. The average annual precipitation is 17 to 18 inches, and the average annual soil temperature is about 40° F. The frost-free season is 65 to 70 days, although frost can occur during any month. The vegetation is Idaho fescue, Columbia needlegrass, and big sagebrush.

In a representative profile the surface layer is dark grayish-brown, dark-gray, or brown, neutral sandy loam about 25 inches thick. The subsoil is yellowish-brown or strong-brown, neutral sandy loam or fine sandy loam that reaches to a depth of 60 inches or more.

Permeability is moderately rapid, and the available water capacity is moderate. The effective rooting depth is 60 inches or more.

These soils are used for range and wildlife habitat.

Representative profile of Sublette sandy loam, in an area of Passcreek-Sublette-Slipman association, in the SE¼SW¼ sec. 25, T. 45 N., R. 84 W.

A11—0 to 6 inches, dark grayish-brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak, medium, crumb structure; loose, very friable; many roots; neutral; clear, smooth boundary.

A12—6 to 18 inches, dark-gray (10YR 4/1) sandy loam, very dark gray (10YR 3/1) moist; weak, coarse, prismatic structure; slightly hard, loose; many roots; neutral; gradual, wavy boundary.

A13—18 to 25 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; weak, coarse, crumb structure; scattered pockets, ½ to 1 inch in size, of material from the A12 horizon; slightly hard, very friable; few roots; neutral; clear, smooth boundary.

B21t—25 to 33 inches, yellowish-brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 4/4) moist; few seams and pockets, 1 inch to 3 inches in size, that are dark yellowish brown (10YR 4/5) moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; few, thin, discontinuous clay films on ped faces; slightly hard, loose; few roots; neutral; clear, smooth boundary.

B22t—33 to 55 inches, yellowish-brown (10YR 5/4) sandy loam, dark yellowish brown (10YR 4/4) moist; weak, medium, prismatic structure parting to weak, medium, angular blocky; few, thin, patchy clay films on ped surfaces; slightly hard, very friable; few roots; neutral; gradual, wavy boundary.

B3—55 to 60 inches, strong-brown (7.5YR 5/6) fine sandy loam, dark brown (7.5YR 3/2) moist; weak, coarse, angular blocky structure; slightly hard, friable; very few roots; neutral.

Thickness of the solum ranges from 30 to 60 inches or more. Content of coarse fragments ranges from 0 to 25 percent but typically is about 15 percent. These soils are neutral or mildly alkaline throughout the profile.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and ranges from 1 to 3 in chroma when dry or moist.

The B2t horizon ranges from 2.5Y to 10YR in hue, ranges from 4 to 6 in value when dry and is 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It generally is sandy loam and has a clay content ranging from 8 to 18 percent. In some places the B horizon extends to a depth of 60 inches or more.

The C horizon, if present, ranges from 2.5Y to 10YR in hue.

Sublette soils are mapped in an association with Passcreek and Slipman soils.

Sunup Series

The Sunup series consists of moderately steep or steep, well-drained to somewhat excessively drained soils. These soils formed in residuum weathered from sandstone and shale on ridges and hillsides. Slopes range from 15 to 40 percent. Elevations range from 5,000 to 6,500 feet. The average annual precipitation is 12 to 13 inches, the average annual soil temperature is about 49° F., and the frost-free season is about 95 to 110 days. The vegetation is bluebunch wheatgrass and threadleaf sedge.

In a representative profile the surface layer is light brownish-gray, moderately alkaline channery clay loam about 5 inches thick. The substratum is olive-colored, moderately alkaline channery clay loam about 9 inches thick. Hard shale and interbedded slate are at a depth of about 14 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is 10 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Sunup channery clay loam, in an area of Sunup-Rock outcrop complex, steep, in the NW¼SE¼ sec. 20, T. 42 N., R. 83 W.

A1—0 to 5 inches, light brownish-gray (2.5Y 6/2) channery clay loam, dark grayish brown (2.5Y 4/2) moist; moderate, fine, granular structure; soft, very friable; 40 percent small shale chips; strong effervescence; moderately alkaline; clear, smooth boundary.

C—5 to 14 inches, olive (5Y 5/3) channery clay loam, olive (5Y 4/3) moist; massive; soft, very friable; 40 percent hard slate and shale chips; strong effervescence; moderately alkaline; abrupt, wavy boundary.

R—14 inches, hard, partly metamorphosed shale and interbedded slate.

Depth to bedrock ranges from 10 to 20 inches. The bedrock consists of hard shale, slate, or interbedded sandstone. Content of coarse fragments ranges from 35 to 80 percent. The fragments are mainly hard shale chips and channery-size fragments of slate and sandstone. The matrix material typically is loam or clay loam, and the content of clay ranges from about 18 to 35 percent.

The A1 horizon ranges from 5Y to 10YR in hue, is 5 or 6 in value when dry and 3 or 4 when moist, and is 2 or 3 in chroma when dry or moist. Where the A1 horizon has a color value as dark as 5 when dry and 3 when moist, it is less than 5 inches thick. This horizon is soft or slightly hard when dry. The A and C horizons are moderately alkaline or strongly alkaline.

The C horizon ranges from 5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist.

Sunup-Carnero association (SW).—This association is about 60 percent Sunup channery clay loam, 15 to 40 percent slopes, and about 25 percent Carnero loam, 10 to 30 percent slopes. The Carnero soil has the profile described as representative of the Carnero series. These soils are on the flanks of mountains, immediately above the red beds. They are on long, fairly narrow ridges, hillsides, and mountain foothills. The Sunup soil is on ridges and hillsides, and the Carnero soil is on mountain foot slopes.

Included with these soils in mapping are areas of Rock outcrop that make up about 15 percent of the acreage.

Runoff is rapid, and the hazard of erosion is high.

Soils of this association are used for range and wildlife habitat. (Sunup soil in capability unit VIIe–14, dryland, and Shallow Clayey range site, 10 to 14 inch precipitation zone. Carnero soil in capability unit VIe–2, dryland, and Loamy range site, 10 to 14 inch precipitation zone)

Sunup-Rock outcrop complex, steep (SVE).—This complex is about 55 percent Sunup channery clay loam, 20 to 40 percent slopes, and about 25 percent Rock outcrop. The Sunup soil has the profile described as representative of the Sunup series. These soils are on ridges, rock ledges, and cliffs. The Sunup soil is on ridges. Areas of this complex extend from the foot of the mountains, where the average annual soil temperature is more than 47° F., upward in elevation to places where the average annual soil temperature is less than 47° F.

Included with these soils in mapping are areas of Carnero soils that make up about 10 percent of the acreage. Also included are areas of Tolman soils that make up about 5 percent and areas of Bayerton soils that make up about 5 percent.

Runoff is rapid, and the hazard of erosion is high.

Soils of this complex are used for range and wildlife habitat. (Capability unit VIIe–14, dryland. Sunup soil in Shallow Clayey range site, 10 to 14 inch precipitation zone; Rock outcrop not in a range site)

Tassel Series

The Tassel series consists of moderately steep or steep, excessively drained soils. These soils formed in residuum weathered from sandstone on ridges. Slopes range from 15 to 40 percent. Elevations range from 4,500 to 5,200 feet. The average annual precipitation is 11 to 12 inches, the average annual soil temperature is about 50° F., and the frost-free season is 105 to 120 days. The vegetation is bluebunch wheatgrass, threadleaf sedge, and cactus.

In a representative profile the surface layer is light olive-brown, moderately alkaline sandy loam about 4 inches thick. The underlying layer is light olive-brown or light yellowish-brown, strongly alkaline sandy loam, about 13 inches thick, that is underlain by sandstone at a depth of about 17 inches.

Permeability is moderately rapid, and the available water capacity is low. The effective rooting depth is 8 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Tassel sandy loam, in an area of Terry-Tassel association, in the SE¼SE¼ sec. 30, T. 44 N., R. 81 W.

A1—0 to 4 inches, light olive-brown (2.5Y 5/4) sandy loam, olive brown (2.5Y 4/4) moist; moderate, medium, crumb structure; loose, very friable; many roots; strong effervescence; moderately alkaline; clear, smooth boundary.

AC—4 to 10 inches, light olive-brown (2.5Y 5/4) sandy loam, yellowish brown (10YR 5/4) moist; weak, medium and fine, crumb structure; soft, very friable; few roots; violent effervescence; strongly alkaline; clear, smooth boundary.

C1ca—10 to 17 inches, light yellowish-brown (10YR 6/4) sandy loam, light olive brown (2.5Y 5/4) moist; massive or weak, coarse, crumb structure; soft, very friable; very few roots; many fine threads of calcium carbonate; violent effervescence; strongly alkaline; clear, smooth boundary.

C2—17 inches, light yellowish-brown, soft, calcareous sandstone.

Depth to bedrock ranges from 8 to 20 inches. Throughout the profile the texture generally is sandy loam and the content of clay ranges from 10 to 18 percent. Content of coarse fragments ranges from 0 to 15 percent but typically is about 5 percent.

The A1 horizon ranges from 5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 3 to 5 in chroma when dry or moist. It ranges from mildly alkaline to strongly alkaline.

The AC and C horizons range from 2.5Y to 10YR in hue, are 5 or 6 in value when dry and range from 4 to 6 when moist, and range from 4 to 6 in chroma when dry and from 3 to 5 when moist. They are moderately alkaline or strongly alkaline. Fine threads and nodules of secondary calcium
Tassel soils are mapped in associations with Cushman,
carbonate are evident in some places but are not consistent.
Pugsley, Shingle, Southfork, Terry, and Valent soil.

Terry Series

The Terry series consists of sloping or moderately steep, well-drained soils. These soils formed in residuum weathered from sandstone on hillsides. Slopes range from 6 to 15 percent. Elevations range from 4,500 to 5,200 feet. The average annual precipitation is 12 to 13 inches, the average annual soil temperature is about 50° F., and the frost-free season is 105 to 120 days. The vegetation is western wheatgrass, blue grama, and cactus.

In a representative profile the surface layer is grayish-brown, mildly alkaline fine sandy loam about 4 inches thick. The upper part of the subsoil is brown, mildly alkaline fine sandy loam about 8 inches thick, and the lower part is light yellowish-brown, strongly alkaline sandy loam about 6 inches thick. The substratum is light yellowish-brown, strongly alkaline fine sandy loam, about 18 inches thick, that is underlain by soft sandstone at a depth of about 36 inches.

Permeability is moderately rapid, and the available water capacity is low to moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Terry fine sandy loam, in an area of Terry-Tassel association, in the NW¼SE¼ sec. 24, T. 44 N., R. 82 W.

A1—0 to 4 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; moderate, fine, crumb structure; soft, very friable; very many roots; mildly alkaline; clear, smooth boundary.

B2t—4 to 12 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; thin patchy clay films on vertical and horizontal surfaces; soft, very friable, slightly sticky; many roots; mildly alkaline; clear, smooth boundary.

B3ca—12 to 18 inches, light yellowish-brown (10YR 6/4) sandy loam, olive brown (2.5Y 4/4) moist; weak, medium, subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few, thin, patchy clay films on ped faces; few roots; violent effervescence; many fine and medium threads and spots of calcium carbonate; strongly alkaline; gradual, wavy boundary.

C1ca—18 to 36 inches, light yellowish-brown (10YR 6/4) fine sandy loam, light olive brown (2.5Y 5/4) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; very few roots; violent effervescence; many fine and few coarse, distinct seams and spots of secondary calcium carbonate; strongly alkaline; gradual, wavy boundary.

C2—36 inches, soft, calcareous, pale-brown sandstone.

Depth to bedrock ranges from 20 to 40 inches, depth to calcareous material ranges from 8 to 20 inches, and thickness of the solum ranges from 15 to 24 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is about 5 percent.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 2 or 3 in chroma when dry or moist. The A1 and B2t horizons are neutral or mildly alkaline.

The B2t horizon ranges from 2.5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 3 to 5 in chroma when dry or moist. It is generally fine sandy loam and has a clay content that ranges from 8 to 18 percent.

The C horizon ranges from 5Y to 10YR in hue. It is moderately alkaline or strongly alkaline.

Terry-Tassel association (TE).—This association is about 35 percent Terry fine sandy loam, 6 to 15 percent slopes; about 25 percent Tassel sandy loam, 15 to 40 percent slopes; and about 20 percent Shingle loam, 10 to 40 percent slopes. The Terry and Tassel soils have the profiles described as representative of the Terry and Tassel series. The depth to bedrock is less than 10 inches in areas where the Tassel or Terry soil has slopes of more than 30 percent. These soils are on hillsides and upland ridges. The Terry soil is on the lower hillsides, the Tassel soil is on ridges underlain by sandstone, and the Shingle soil is on ridge crests that are underlain by siltstone.

Included with these soils in mapping are areas of Cushman soils that make up about 10 percent of the acreage. Also included are areas of Valent soils that make up about 5 percent and areas of Rock outcrop that make up about 5 percent.

Runoff is medium to rapid on the Terry soil and rapid on the Tassel and Shingle soils. The hazard of erosion is high on the Shingle soils. The hazard of water erosion is moderate to high on the Terry soil and high on the Tassel soil, and if the cover is destroyed on these soils, the hazard of wind erosion is high.

Soils of this association are used for range and wildlife habitat. (Terry soil in capability unit VIe–5, dryland, and Sandy range site, 10 to 14 inch precipitation zone. Tassel and Shingle soils in capability unit VIIe–14, dryland; Tassel soil in Shallow Sandy range site, 10 to 14 inch precipitation zone; Shingle soil in Shallow Loamy range site, 10 to 14 inch precipitation zone)

Tolman Series

The Tolman series consists of moderately steep or steep, well-drained soils. These soils formed in residuum weathered from sandstone on east-facing slopes of the mountains. Slopes range from 10 to 40 percent. Elevations range from 6,000 to 7,500 feet. The average annual precipitation is 14 to 16 inches, the average annual soil temperature is 44 to 46° F., and the frost-free season is 80 to 85 days. The vegetation is mainly Idaho fescue and scattered ponderosa pine.

In a representative profile the surface layer is grayish-brown, slightly acid very stony loam about 4 inches thick. The subsoil is brown, neutral gravelly loam or very gravelly clay loam, about 12 inches thick, that is underlain by hard sandstone at a depth of about 16 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is 10 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Tolman very stony loam, in an area of Bayerton-Tolman association, in the SW¼SW¼ sec. 30, T. 45 N., R. 83 W.

A1—0 to 4 inches, grayish-brown (10YR 5/2) very stony loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, crumb structure; soft, very friable; 20 percent stones, most of which are more than 10 inches in diameter; slightly acid; clear, wavy boundary.

B1—4 to 7 inches, brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) moist; moderate, fine, subangular blocky structure parting to moderate, fine, granular; 15 percent pebbles and cobblestones; slightly hard, very friable; few, thin, glossy patches on ped faces; some glossy coatings on coarse fragments; neutral; gradual, wavy boundary.

B2t—7 to 16 inches, brown (7.5YR 5/3) very gravelly clay loam, dark brown (7.5YR 4/3) moist; weak, medium,

prismatic structure parting to moderate, medium, subangular blocky; hard, very friable; many, thin, waxlike patches on ped faces; waxlike coatings on coarse fragments and on inside of root channels; 60 percent pebbles and cobblestones; neutral; abrupt, wavy boundary.

R—16 inches, hard, sandstone bedrock.

Depth to bedrock ranges from 10 to 20 inches. The B2t horizon typically rests directly on bedrock, but a thin C horizon is in some profiles. Content of coarse fragments ranges from 35 to 75 percent. The fragments are mainly sandstone pebbles and cobblestones less than 10 inches in diameter.

The A1 horizon ranges from 5Y to 10YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. This horizon is soft or slightly hard when dry. The A and B horizons range from medium acid to mildly alkaline.

The B1 horizon is 10YR or 7.5YR in hue, 4 or 5 in value when dry and 2 or 3 when moist, and 2 or 3 in chroma when dry or moist. The B2t horizon ranges from 10YR to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. In most places the primary structure is prismatic, but in some places it is subangular blocky. It generally has texture of very gravelly loam or clay loam and clay content that ranges from 18 to 35 percent.

Tolman soils are mapped in an association with Bayerton soils.

Travessilla Series

The Travessilla series consists of moderately steep or steep, somewhat excessively drained soils. These soils formed in residuum weathered from sandstone on ridges and hillsides. Slopes range from 15 to 40 percent. Elevations range from 4,500 to 5,500 feet. The average annual precipitation is 10 to 12 inches, the average annual soil temperature is about 51° F., and the frost-free season is 100 to 105 days. The vegetation is threadleaf sedge and western wheatgrass.

In a representative profile the surface layer is grayish-brown, mildly alkaline sandy loam about 2 inches thick. The underlying layer is brown, moderately alkaline sandy loam about 10 inches thick that is underlain by hard, calcareous sandstone at a depth of about 12 inches.

Permeability is rapid, and the available water capacity is low. The effective rooting depth is 10 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Travessilla sandy loam, in an area of Travessilla-Rock outcrop complex, steep, in the NW¼NE¼ sec. 22, T. 42 N., R. 82 W.

A1—0 to 2 inches, grayish-brown (2.5Y 5/2) sandy loam, dark grayish brown (2.5Y 4/2) moist; weak, medium, granular structure; soft, very friable; many roots; mildly alkaline; clear, smooth boundary.

AC—2 to 8 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; massive to single grained; soft, very friable; few roots; slight effervescence; moderately alkaline; clear, smooth boundary.

Cca—8 to 12 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; massive; soft, very friable; few roots; few small sandstone fragments; many fine threads of carbonates; strong effervescence; moderately alkaline; clear, smooth boundary.

R—12 inches, hard, calcareous sandstone.

These soils generally are calcareous to the surface, but in places they are noncalcareous in the uppermost 2 or 3 inches. Depth to hard bedrock ranges from 10 to 20 inches. Texture typically is sandy loam that is 10 to 18 percent clay throughout the profile. Content of coarse fragments ranges from 0 to 15 percent but typically is about 5 percent.

The A1 horizon ranges from 5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It is mildly alkaline or moderately alkaline.

The C horizon ranges from 5Y to 10YR in hue, is 5 or 6 in value when dry or 4 or 5 when moist, and is 3 or 4 in chroma when dry or moist. It is moderately alkaline or strongly alkaline. Secondary carbonates in the form of threads and nodules are common in most places.

Travessilla-Rock outcrop complex, steep (TRE).—This complex is about 55 percent Travessilla sandy loam, 15 to 40 percent slopes, and about 30 percent Rock outcrop. The Travessilla soil has the profile described as representative of the Travessilla series. The depth to bedrock is 8 to 10 inches in areas where slopes are more than 30 percent. These soils are on long, winding ridges. The Travessilla soil is on ridgetops and hillsides, and Rock outcrop occurs as ledges and cliffs, mainly on the upper part of the landscape.

Included with these soils in mapping are areas of Zigweid soils that make up about 10 percent of the acreage and areas of Shingle soils that make up about 5 percent.

Runoff is rapid, and the hazard of water erosion is high. If the cover is destroyed, the hazard of wind erosion is high.

Soils of this complex are used for range and wildlife habitat. (Capability unit VIIe-14, dryland. Travessilla soil in Shallow Sandy range site, 10 to 14 inch precipitation zone; Rock outcrop not in range site)

Tripit Series

The Tripit series consists of sloping or moderately steep, well-drained soils. These soils formed in residuum weathered from reddish-colored sandstone and shale on hillsides and foot slopes in the mountains. Slopes range from 6 to 20 percent. Elevations range from 7,500 to 9,000 feet. The average annual precipitation is 17 to 18 inches, and the average annual soil temperature is about 41° F. The frost-free season is 60 to 65 days, although frost can occur during any month. The vegetation is Idaho fescue, king fescue, and big sagebrush.

In a representative profile the surface layer is dark-brown, neutral loam about 4 inches thick. The upper part of the subsoil is dark reddish-gray or reddish-brown, mildly alkaline loam or clay loam about 8 inches thick, and the lower part is red, moderately alkaline gravelly clay loam or gravelly loam, about 18 inches thick, that is underlain by red shale at a depth of about 30 inches.

Permeability and the available water capacity are moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Tripit loam, in an area of Tripit-Devoe association, in the SW¼SE¼ sec. 17, T. 45 N., R. 84 W.

A1—0 to 4 inches, dark-brown (7.5YR 4/2) loam, dark brown (7.5YR 3/2) moist; strong, fine, granular or crumb structure; slightly hard, very friable; neutral; clear, smooth boundary.

B1—4 to 8 inches, dark reddish-gray (5YR 4/2) loam, dark reddish brown (5YR 3/2) moist; weak, coarse, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, very friable; few, thin, glossy patches on ped faces; mildly alkaline; clear, smooth boundary.

B21t—8 to 12 inches, reddish-brown (2.5YR 5/3) clay loam, dark reddish brown (2.5YR 3/3) moist; moderate, medium, prismatic structure parting to strong, me-

dium, subangular blocky; hard, very friable; peds are very hard; thin, nearly continuous, waxlike coatings on ped faces; mildly alkaline; clear, smooth boundary.

B22t—12 to 24 inches, red (2.5YR 5/6) gravelly clay loam, red (2.5YR 4/6) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, very friable; peds are extremely hard; thin, continuous, waxlike coatings on ped faces; 50 percent limestone gravel; strong effervescence; moderately alkaline; gradual, wavy boundary.

B3—24 to 30 inches, red (2.5YR 5/6) gravelly loam, red (2.5YR 4/6) moist; moderate, medium, subangular blocky structure; hard, very friable; peds are extremely hard; moderate numbers of thin glossy patches on ped faces; some glossy coatings in root channels; 25 percent limestone gravel; strong effervescence; moderately alkaline; gradual, wavy boundary.

C—30 inches, red, calcareous shale that has interbedded, thin lenses of limestone.

Depth to bedrock ranges from 20 to 40 inches, depth to calcareous material ranges from 8 to 20 inches, and thickness of the solum ranges from 15 to 40 inches. Content of coarse fragments ranges from 10 to 35 percent.

The A1 horizon ranges from 7.5YR to 5YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. It is neutral or mildly alkaline. In most places the primary structure is crumb or granular, but in some places it is subangular blocky. This horizon is soft or slightly hard when dry.

The B21t horizon ranges from 5YR to 10R in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. The B22t horizon ranges from 5YR to 10R in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 4 to 6 in chroma when dry or moist. It ranges from neutral to moderately alkaline. In most places the primary structure is prismatic, but in some places it is subangular blocky structure. It is generally clay loam, and the content of clay ranges from 18 to 35 percent. The lower part of the B2t horizon generally is calcareous, particularly where there is no underlying C horizon. The B2t and B3 horizons do not have a continuous horizon of visible secondary calcium carbonate accumulation.

Tripit-Devoe association (TS).—This association is about 45 percent Tripit loam, 6 to 20 percent slopes; about 25 percent Devoe gravelly loam, 15 to 40 percent slopes; and about 15 percent Amsden loam, 6 to 15 percent slopes. The Tripit soil has the profile described as representative of the Tripit series. These soils are on high, prominent ridges, hillsides, foot slopes, and alluvial fans, all in the mountains. The Tripit soil is on hillsides and upper foot slopes, the Devoe soil is on ridges and ridge crests, and the Amsden soil is on the lower foot slopes and alluvial fans.

Included with these soils in mapping are areas of reddish-colored, clayey soils similar to this Tripit soil that make up about 10 percent of the acreage and areas of Rock outcrop that make up about 5 percent.

Runoff is medium to rapid on the Tripit and Amsden soils and rapid on the Devoe soil. The hazard of erosion is moderate to high on the Tripit and Amsden soils and high on the Devoe soil.

Soils of this association are used for range and wildlife habitat. (Tripit and Amsden soils in capability unit VIe–2, dryland, and Loamy range site, 15 to 19 inch precipitation zone. Devoe soil in capability unit VIIe–14, dryland, and Shallow Clayey range site, 15 to 19 inch precipitation zone)

Tripit-Sawcreek association (TT).—This association is about 50 percent Tripit loam, 6 to 20 percent slopes, and about 30 percent Sawcreek sandy loam, 6 to 20 percent slopes. These soils are rolling or hilly. The Sawcreek soil has the profile described as representative of the Sawcreek series. These soils are on uplands in the mountains. The Tripit soil is on hillsides, and the Sawcreek soil is on the lower hillsides, mainly below ledges of sandstone.

Included with these soils in mapping are areas of reddish-colored, clayey soils similar to this Tripit soil that make up 10 to 20 percent of the acreage. Also included are areas of Devoe soils that make up about 5 percent and sandstone rock ledges that make up about 5 percent.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. If the cover is destroyed, the hazard of wind erosion is high on the Sawcreek soil.

Soils of this association are used for range and wildlife habitat. (Tripit soil in capability unit VIe–2, dryland, and Loamy range site, 15 to 19 inch precipitation zone. Sawcreek soil in capability unit VIe–5, dryland, and Sandy range site, 15 to 19 inch precipitation zone)

Turk Series

The Turk series consists of sloping or moderately steep, well-drained soils. These soils formed in residuum weathered from shale on hillsides and foot slopes in the mountains. Slopes range from 6 to 20 percent. Elevations range from 8,000 to 9,500 feet. The average annual precipitation is 18 to 19 inches, and the average annual soil temperature is about 41° F. The frost-free season is 60 to 65 days, although frost can occur during any month. The vegetation is Idaho fescue, silvery lupine, and big sagebrush.

In a representative profile the surface layer is dark-gray, neutral silty clay loam about 3 inches thick. The subsoil is very dark grayish-brown, neutral clay about 12 inches thick. The substratum is grayish-brown or very pale brown, strongly alkaline or moderately alkaline clay or silty clay, about 21 inches thick, that is underlain by soft shale at a depth of about 36 inches.

Permeability is slow, and the available water capacity is low to moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Turk silty clay loam, in an area of Turk-Lymanson-Jenkinson association, in the NE¼NE¼ sec. 28, T. 45 N., R. 85 W.

A1—0 to 3 inches, dark-gray (10YR 4/1) silty clay loam, very dark brown (10YR 2/2) moist; strong, medium, crumb structure; hard, firm, sticky and plastic; many roots; neutral; clear, smooth boundary.

B21t—3 to 9 inches, very dark grayish-brown (10YR 3/2) clay, very dark brown (10YR 2/2) moist; strong, medium, prismatic structure parting to strong, fine, angular blocky; very hard, very firm, very sticky and very plastic; thick continuous clay films on all ped surfaces; many roots; neutral; clear, smooth boundary.

B22t—9 to 15 inches, very dark grayish-brown (10YR 3/2) clay, very dark brown (10YR 2/2) moist; strong, medium, angular blocky structure; extremely hard, extremely firm, very sticky and very plastic; thick continuous clay films on all ped faces; few roots; neutral; clear, wavy boundary.

C1ca—15 to 27 inches, grayish-brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; massive; hard, firm, sticky and plastic; a few seams and spots of secondary carbonate accumulations; violent effervescence; strongly alkaline; clear, wavy boundary.

C2—27 to 36 inches, very pale brown (10YR 7/4) silty clay, light yellowish brown (10YR 6/4) moist; structureless; hard, firm, sticky and plastic; many olive-brown shale chips and platelets throughout the horizon; strong effervescence; moderately alkaline; gradual, irregular boundary.

C3—36 inches, light olive-brown, soft, calcareous shale.

Depth to shale bedrock ranges from 20 to 40 inches, and depth to calcareous material ranges from 8 to 25 inches. Content of coarse fragments ranges from 0 to 5 percent.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 1 or 2 in chroma when dry or moist. It is neutral or mildly alkaline.

The B2t horizon ranges from 5Y to 10YR in hue, ranges from 3 to 5 in value when dry and is 2 or 3 when moist, and ranges from 1 to 4 in chroma when dry or moist. It ranges from neutral to moderately alkaline. In most places it has prismatic structure, but in some places it has angular blocky structure. It typically has more than 60 percent clay content.

The Cca horizon ranges from 5Y to 10YR in hue. It is moderately alkaline or strongly alkaline. Secondary calcium carbonates in the form of seams, threads, and nodules are common in the C horizon; however, in many profiles none is visible in the lower part of the C horizon.

Turk-Lymanson-Jenkinson association (TU).—This association is about 35 percent Turk silty clay loam, 6 to 20 percent slopes; about 25 percent Lymanson loam, 10 to 30 percent slopes; and about 20 percent Jenkinson channery clay loam, 10 to 30 percent slopes. These soils have the profiles described as representative of the Turk, Lymanson, and Jenkinson series. They occupy high, prominent ridges in the mountains. The Turk soil is on lower foot slopes, the Lymanson soil is on ridges, and the Jenkinson soil is on hillsides.

Included with these soils in mapping are areas of Stubbs soils that make up about 15 percent of the acreage and areas of noncalcareous soils similar to this Stubbs soil that make up about 5 percent.

Runoff is medium to rapid on the Turk soil and rapid on the Lymanson and Jenkinson soils. The hazard of erosion is high on the Lymanson and Jenkinson soils and moderate to high on the Turk soil.

Soils of this association are used for range and wildlife habitat. (Turk soil in capability unit VIe–1, dryland, and Clayey range site, 15 to 19 inch precipitation zone. Lymanson soil in capability unit VIe–2, dryland, and Loamy range site, 15 to 19 inch precipitation zone. Jenkinson soil in capability unit VIIe–14, dryland, and Shallow Clayey range site, 15 to 19 inch precipitation zone)

Ulm Series

The Ulm series consists of nearly level to sloping, well-drained soils. These soils formed in alluvium derived from siltstone and shale. They are on alluvial fans. Slopes range from 0 to 10 percent. Elevations range from 4,500 to 5,000 feet. The average annual precipitation is 10 to 13 inches, the average annual soil temperature is about 51° F., and the frost-free season is 105 to 120 days. The vegetation is western wheatgrass, big sagebrush, and blue grama.

In a representative profile the surface layer is light brownish-gray, neutral loam about 3 inches thick. The upper part of the subsoil is grayish-brown or brown, mildly alkaline clay loam about 15 inches thick. The lower part of the subsoil is light brownish-gray, moderately alkaline clay loam about 8 inches thick. The substratum is light yellowish-brown, strongly alkaline clay loam that reaches to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more.

These soils are used for range, as wildlife habitat, and to a lesser extent for irrigated hay, pasture, and small grain and for dryland spring wheat and hay.

Representative profile of Ulm loam, in an area of Fort Collins-Ulm association, in the SW$\frac{1}{4}$SW$\frac{1}{4}$ sec. 23, T. 45 N., R. 82 W.

A1—0 to 3 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; moderate, fine, granular structure; soft, friable, nonsticky and nonplastic; many roots; neutral; clear, smooth boundary.

B1—3 to 7 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; strong, fine, subangular blocky structure; thick discontinuous clay films; slightly hard, firm, slightly sticky and slightly plastic; many roots; mildly alkaline; clear, smooth boundary.

B2t—7 to 18 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; strong, fine, prismatic structure parting to strong, fine, subangular blocky; thick continuous clay films; very hard, firm, sticky and plastic; few roots; mildly alkaline; clear, smooth boundary.

B3ca—18 to 26 inches, light brownish-gray (2.5Y 6/2) clay loam, light olive brown (2.5Y 5/4) moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; thin discontinuous or patchy clay films; hard, firm, sticky and plastic; many fine threads and concretions of secondary calcium carbonate; strong effervescence; moderately alkaline; gradual, smooth boundary.

Cca—26 to 60 inches, light yellowish-brown (2.5Y 6/4) clay loam, light olive brown (2.5Y 5/4) moist; massive; hard, friable, sticky and slightly plastic; few fine threads and specks of secondary lime carbonate; strong effervescence; strongly alkaline.

Depth to calcareous material ranges from 12 to 30 inches, and thickness of the solum ranges from 15 to 36 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent.

The A1 horizon ranges from 2.5Y to 10YR in hue, from 5 to 7 in value when dry and from 3 to 5 when moist, and from 2 to 4 in chroma when dry or moist. Where the A1 horizon has a color value as dark as 5 when dry and 3 when moist, it is less than 5 inches thick. It is neutral or mildly alkaline.

The B2t horizon ranges from 2.5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It is neutral or mildly alkaline. In most places it has prismatic structure, but in some places it has subangular blocky structure. It is generally clay or clay loam and has a clay content of 35 to 50 percent.

The C horizon ranges from 5Y to 10YR in hue. It is moderately alkaline or strongly alkaline.

Ulm loam, 0 to 3 percent slopes (UlA).—This soil is on alluvial fans, mainly in stream valleys above creek bottoms on the Middle Fork of Powder River and on Powder River below Sussex. It has a profile similar to the one described as representative of the series, except that the surface layer is about 8 inches thick. In some places the surface layer is clay loam.

Included with this soil in mapping are areas of Fort Collins and Wyarno soils.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for irrigated hay, pasture, and small grain. A small acreage is used for dryland spring wheat and hay and for range. (Capability units IVe–2, dryland,

and IIe-2, irrigated; Loamy range site, 10 to 14 inch precipitation zone)

Ulm loam, 3 to 6 percent slopes (UlB).—This soil is on alluvial fans, mainly in valleys above creek bottoms. It has a profile similar to the one described as representative of the series, except that the surface layer is about 6 inches thick.

Included with this soil in mapping are areas of Fort Collins and Wyarno soils.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for irrigated hay, pasture, and small grain and to a lesser extent for dryland spring wheat and hay and for range. (Capability units IVe-2, dryland, and IIIe-2, irrigated; Loamy range site, 10 to 14 inch precipitation zone)

Ulm-Cushman association (UM).—This association is about 40 percent Ulm loam, 6 to 10 percent slopes; about 25 percent Cushman fine sandy loam, 6 to 20 percent slopes; and about 20 percent Maysdorf sandy loam, 6 to 15 percent slopes. These soils occupy uplands, foot slopes, and alluvial fans. The Ulm soil is on alluvial fans, mainly at the lower end of the landscape; the Cushman soil is on the tops and shoulders of upland ridges; and the Maysdorf soil is on hillsides and foot slopes. These soils are rolling or hilly.

Included with these soils in mapping are areas of Briggsdale soils that make up about 10 percent of the acreage and areas of Terry soils that make up about 5 percent.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. If the cover is destroyed, the hazard of wind erosion is high on the Cushman and Maysdorf soils.

Soils of this association are used for range and wildlife habitat. (Ulm and Cushman soils in capability unit VIe-2, dryland; Maysdorf soil in capability unit VIe-5, dryland. All three soils in Loamy range site, 10 to 14 inch precipitation zone)

Ulm-Wyarno association (UW).—This association is about 50 percent Ulm loam, 0 to 6 percent slopes, and about 30 percent Wyarno clay loam, 0 to 6 percent slopes. These soils occupy alluvial fans. The areas are mainly 1/8 to 3/4 mile long and 100 feet to 1/4 mile wide. Generally, the Wyarno soil is on the upper end, and the Ulm soil is on the lower end of these areas.

Included with these soils in mapping are areas of Stoneham soils that make up about 10 percent of the acreage. Also included are areas of Heldt soils that make up 5 percent and areas of Limon soils that make up about 5 percent.

Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Soils of this association are used for range and wildlife habitat. (Ulm soil in capability unit IVe-2, dryland, and Loamy range site, 10 to 14 inch precipitation zone. Wyarno soil in capability unit IVe-1, dryland, and Clayey range site, 10 to 14 inch precipitation zone)

Valent Series

The Valent series consists of sloping or moderately steep, excessively drained soils. These soils formed in wind-laid sand on hillsides. Slopes range from 6 to 20 percent. Elevations range from 4,500 to 5,500 feet. The average annual precipitation is 10 to 12 inches, the average annual soil temperature is about 52° F., and the frost-free season is 105 to 120 days. The vegetation is Indian ricegrass and prairie sandreed.

In a representative profile the surface layer is light brownish-gray, neutral loamy sand about 2 inches thick. The underlying layer is pale-olive or light brownish-gray, neutral fine sand that reaches to a depth of 60 inches or more.

Permeability is rapid, and the available water capacity is low. The effective rooting depth is 60 inches or more.

These soils are used for range and wildlife habitat.

Representative profile of Valent loamy sand in the NE1/4NE1/4 sec. 4, T. 45 N., R. 78 W.

A1—0 to 2 inches, light brownish-gray (2.5Y 6/2) loamy sand, grayish brown (2.5Y 5/2) moist; weak, coarse, crumb structure crushing to single grained; loose; neutral; clear, smooth boundary.

C1—2 to 12 inches, pale-olive (5Y 6/4) fine sand, light olive brown (2.5Y 5/4) moist; single grained; loose; many roots; many, fine, dark grayish-brown sand grains in matrix; neutral; clear, smooth boundary.

C2—12 to 60 inches, light brownish-gray (2.5Y 6/2) fine sand, olive brown (2.5Y 4/4) moist; weak, coarse, crumb structure crushing to single grained; loose; many roots in upper 13 inches but few below; many, fine, dark grayish-brown sand grains in matrix; neutral.

Depth to bedrock is more than 40 inches and, in most places, more than 60 inches. Depth to calcareous material generally is 60 inches or more. Content of coarse fragments ranges from 0 to 5 percent but typically is less than 2 percent.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 5 or 6 in value when dry and ranges from 3 to 5 when moist, and is 2 or 3 in chroma when dry or moist. It typically is less than 6 inches thick. It ranges from slightly acid to mildly alkaline.

The C horizon ranges from 5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 5 in chroma when dry or moist. It is generally fine sand, but the content of clay ranges from 0 to 12 percent. It is neutral or mildly alkaline.

Valent-Cushman association (VC).—This association is about 30 percent Valent loamy sand, 6 to 20 percent slopes; about 25 percent Cushman fine sandy loam, 6 to 20 percent slopes; and about 25 percent Tassel sandy loam, 15 to 40 percent slopes. The Valent soil has the profile described as representative of the Valent series. These soils occupy uplands. Generally, the Valent soil is on the leeward sides of hills, the Cushman soil is on the upper hillsides, and the Tassel soil is on ridges. These soils are rolling to steep.

Included with these soils in mapping are areas of soils that are similar to this Tassel soil and that make up about 10 percent of the acreage. These soils differ from the Tassel soil in that they are noncalcareous. Also included are areas of Terry soils that make up about 5 percent of the acreage, sandstone Rock outcrop that makes up about 5 percent, and blowout areas that make up about 5 percent.

Runoff is slow to medium on the Cushman and Valent soils and rapid on the Tassel soil. The hazard of water erosion is slight to moderate on the Cushman and Valent soils and high on the Tassel soil. If the cover is destroyed, the hazard of wind erosion is very high on the Valent soil and high on the Cushman and Tassel soils.

Soils of this association are used for range and wildlife habitat. (Valent soil in capability unit VIIe-15, dry-

land, and Sands range site, 10 to 14 inch precipitation zone. Cushman soil in capability unit VIe-2, dryland, and Loamy range site, 10 to 14 inch precipitation zone. Tassel soil in capability unit VIIe-14, dryland, and Shallow Sandy range site, 10 to 14 inch precipitation zone)

Wetterhorn Series

The Wetterhorn series consists of sloping or moderately steep, well-drained soils. These soils formed in residuum weathered from sandstone and shale. They are on timbered hillsides in the mountains. Slopes range from 6 to 20 percent. Elevations range from 7,500 to 9,000 feet. The average annual precipitation is 18 to 19 inches, and the average annual soil temperature is about 40° F. The frost-free season is 60 to 65 days, although frost can occur during any month. The vegetation is lodgepole pine.

In a representative profile about 1 inch of forest litter covers a surface layer of grayish-brown, slightly acid sandy loam about 4 inches thick. The upper part of the subsurface layer is very pale brown, medium acid very fine sandy loam about 6 inches thick, and the lower part is brown, medium acid clay loam that is mixed with material from the upper part of the subsurface layer and is about 5 inches thick. The subsoil is yellowish-brown, slightly acid clay loam or stony clay loam, about 21 inches thick, that is underlain by sandstone at a depth of about 36 inches.

Permeability is moderately slow, and the available water capacity is moderate. The effective rooting depth is 20 to 40 inches.

These soils are used as woodland, wildlife habitat, and watershed.

Representative profile of Wetterhorn sandy loam, in an area of Sanford-Wetterhorn association, near the center of sec. 3, T. 46 N., R. 85 W.

O1—1 inch to 0, mulch of pine needles (forest litter).

A1—0 to 4 inches, grayish-brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) moist; moderate, thin, platy structure; soft, very friable; few roots; slightly acid; clear, smooth boundary.

A2—4 to 10 inches, very pale brown (10YR 7/3) very fine sandy loam, brown (10YR 5/3) moist; strong, very fine, angular blocky structure; soft, very friable; very few roots; medium acid; abrupt, smooth boundary.

A&B—10 to 15 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; many bleached sand grains and specks of A2 material throughout matrix; strong, fine, angular blocky structure; thick continuous clay films on all ped faces; slightly hard, firm, sticky and plastic; very few roots; medium acid; clear, smooth boundary.

B21t—15 to 20 inches, yellowish-brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; weak, coarse, angular blocky structure; thin discontinuous clay films; hard, firm, very sticky and plastic; scattered roots; slightly acid; clear, smooth boundary.

B22t—20 to 36 inches, yellowish-brown (10YR 5/4) stony clay loam, dark yellowish brown (10YR 4/4) moist; moderate, medium, angular blocky structure; no visible clay films; 15 to 25 percent of soil mass is angular sandstone fragments; very hard, extremely firm, very sticky and plastic; slightly acid; clear, smooth boundary.

R—36 inches, yellowish-brown, noncalcareous sandstone.

Depth to bedrock and thickness of the solum range from 20 to 40 inches. Content of coarse fragments ranges from 10 to 30 percent. These soils range from medium acid to neutral throughout the profile.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It ranges from 1 to 5 inches in thickness. The A2 horizon ranges from 10YR to 5YR in hue, ranges from 5 to 7 in value when dry and is 4 or 5 when moist, and ranges from 3 to 5 in chroma when dry or moist.

The B2t horizon ranges from 10YR to 5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and is 3 or 4 in chroma when dry or moist. It is generally stony clay loam, but in places it ranges to stony clay. The content of clay ranges from 35 to 50 percent.

In some places there is a C horizon 8 to 10 inches thick. In these places the C horizon ranges from 10YR to 5YR in hue.

Wetterhorn soils are mapped in an association with Sanford soils.

Wolf Series

The Wolf series consists of nearly level to moderately steep, well-drained soils. These soils formed in alluvium on high terraces and hillsides, mainly on the mesa near Mayoworth. Slopes range from 0 to 15 percent. Elevations range from 5,000 to 5,500 feet. The average annual precipitation is 12 to 14 inches, the average annual soil temperature is 50° to 51° F., and the frost-free season is 95 to 110 days. The vegetation is western wheatgrass, blue grama, and big sagebrush.

In a representative profile the surface layer is grayish-brown, neutral loam about 4 inches thick. The upper part of the subsoil is brown, mildly alkaline clay loam about 6 inches thick, and the lower part is light brownish-gray, moderately alkaline clay loam about 4 inches thick. The substratum is white or light brownish-gray, moderately alkaline gravelly clay loam that reaches to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more.

These soils are used for range and wildlife habitat.

Representative profile of Wolf loam, in an area of Wolf-Cragola association, in the SE¼SE¼ sec. 9, T. 45 N., R. 82 W.

A1—0 to 4 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate, fine, granular structure; soft, very friable; 5 percent gravel; neutral; gradual, smooth boundary.

B2t—4 to 10 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; strong, medium, prismatic structure parting to strong, fine, angular blocky; slightly hard, friable; peds are very hard; thin, continuous, waxlike coatings on ped faces; waxlike coatings and fillings on inside of root channels and pores; 5 percent gravel; mildly alkaline; gradual, smooth boundary.

B3ca—10 to 14 inches, light brownish-gray (10YR 6/2) clay loam, grayish brown (10YR 5/2) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, very friable; peds are very hard; few, thin, glossy patches on ped faces; 10 percent gravel; visible secondary calcium carbonate occuring as concretions; strong effervescence; moderately alkaline; gradual, smooth boundary.

C1ca—14 to 30 inches, white (10YR 8/2) gravelly clay loam, light brownish gray (10YR 6/2) moist; massive; hard, very friable; 20 percent secondary calcium

carbonate occurring as concretions, in finely divided, marllike forms, and as coatings on gravel fragments; violent effervescence; moderately alkaline; diffuse, smooth boundary.

C2ca—30 to 60 inches, light brownish-gray (10YR 6/2) gravelly clay loam, grayish brown (10YR 5/2) moist; massive; hard, very friable; visible secondary calcium carbonate occurring as concretions and in thin seams and streaks; 25 percent gravel; violent effervescence; moderately alkaline.

Depth to calcareous material ranges from 6 to 11 inches. Content of coarse fragments ranges from 0 to 35 percent but typically is less than 15 percent in the solum and more than 15 percent above a depth of 40 inches in the C horizon.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist.

The B2t horizon ranges from 2.5Y to 10YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. It is neutral or mildly alkaline.

The Cca horizon ranges from 2.5Y to 10YR in hue. It is moderately alkaline or strongly alkaline. The calcium carbonate equivalent in the strongest part of the Cca horizon ranges from 15 to 30 percent.

Wolf-Cragola association (WC).—This association is about 50 percent Wolf loam, 6 to 15 percent slopes, and about 30 percent Cragola very gravelly loam, 10 to 40 percent slopes. The Wolf soil has the profile described as representative of the Wolf series. The Wolf soil is on hillsides, and the Cragola soil is on ridges.

Included with these soils in mapping are areas of Big Horn and Shingle soils that make up about 10 percent of the acreage.

Runoff is medium to rapid on the Wolf soil and rapid on the Cragola soil. The hazard of erosion is moderate to high on the Wolf soil and high on the Cragola soil.

Soils of this association are used for range and wildlife habitat. (Wolf soil in capability unit VIe–2, dryland, and Loamy range site, 10 to 14 inch precipitation zone. Cragola soil in capability unit VIIe–14, dryland, and Shallow Clayey range site, 10 to 14 inch precipitation zone)

Woosley Series

The Woosley series consists of sloping or moderately steep, well-drained soils. These soils formed in residuum weathered from limestone on mountain hillsides. Slopes range from 6 to 20 percent. Elevations range from 7,800 to 9,000 feet. The average annual precipitation is 17 to 18 inches, and the average annual soil temperature is about 42° F. The frost-free season is 60 to 65 days, although frost can occur during any month. The vegetation is big sagebrush, Idaho fescue, and Columbia needlegrass.

In a representative profile the surface layer is dark grayish-brown, neutral loam about 9 inches thick. The upper part of the subsoil is grayish-brown or brown, neutral loam or clay loam about 17 inches thick, and the lower part is light brownish-gray, moderately alkaline loam about 4 inches thick. The substratum is light brownish-gray, moderately alkaline loam, about 5 inches thick, that is underlain by hard limestone at a depth of about 35 inches.

Permeability is moderate, and the available water capacity is moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range and wildlife habitat.

Representative profile of Woosley loam, in an area of Nathrop-Woosley association, one-fourth of a mile west of the northeast corner of sec. 6, T. 45 N., R. 84 W.

A1—0 to 9 inches, dark grayish-brown (10YR 4/2) loam, very dark brown (10YR 2/2) moist; weak, medium, subangular blocky structure parting to strong, fine, granular; soft, very friable; 5 percent fine limestone gravel; neutral; clear, smooth boundary.

B1—9 to 12 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, very friable; 10 percent fine limestone gravel; thin glossy patches on some ped faces; neutral; clear, smooth boundary.

B2t—12 to 26 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, friable; 10 percent fine limestone gravel; thin, continuous, waxlike coatings on ped faces; thin waxlike coatings on inside of root channels; neutral; clear, smooth boundary.

B3ca—26 to 30 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak, medium, subangular blocky structure; hard, very friable; few, thin, glossy patches on ped faces; 10 percent fine limestone gravel; visible secondary calcium carbonate occurring as concretions and in thin seams and streaks; strong effervescence; moderately alkaline; gradual, smooth boundary.

Cca—30 to 35 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; massive; hard, very friable; 10 percent fine limestone gravel; visible secondary calcium carbonate occurring as concretions and in thin seams and streaks; strong effervescence; moderately alkaline; gradual, smooth boundary.

R—35 inches, hard limestone bedrock.

Depth to bedrock and thickness of the solum range from 20 to 40 inches. Depth to calcareous material ranges from 15 to 30 inches. Content of coarse fragments ranges from 5 to 15 percent. The fragments are mostly fine limestone gravel.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. It is slightly acid or neutral. This horizon is soft or slightly hard when dry.

The B2t horizon ranges from 10YR to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It is neutral or mildly alkaline. In most places the primary structure is prismatic, but in some places it is subangular blocky. It is generally clay loam and the clay content ranges from 18 to 35 percent.

The Cca horizon ranges from 10YR to 2.5Y in hue. It is moderately alkaline or strongly alkaline. The calcium carbonate equivalent of the fine earth ranges from 6 to about 15 percent.

Woosley soils are mapped in associations with Decross and Nathrop soils.

Worf Series

The Worf series consists of sloping to steep, well-drained soils. These soils formed in residuum weathered from sandstone and siltstone on hillsides and ridges. Slopes range from 6 to 30 percent. Elevations range from 4,500 to 5,200 feet. The average annual precipitation is 10 to 13 inches, the average annual soil temperature is about 50° F., and the frost-free season is 100 to 120 days. The vegetation is western wheatgrass and threadleaf sedge.

In a representative profile the surface layer is grayish-brown, mildly alkaline loam about 3 inches thick. The upper part of the subsoil is grayish-brown or brown, mildly alkaline loam or clay loam about 6 inches thick, and the

lower part is light yellowish-brown, moderately alkaline loam, about 5 inches thick, that is underlain by interbedded shale and loamstone at a depth of about 14 inches.

Permeability is moderate, and the available water capacity is low. The effective rooting depth is 10 to 20 inches.

These soils are used for range and wildlife habitat.

Representative profile of Worf loam, in an area of Briggsdale-Worf association, rolling, in the NW¼ sec. 21, T. 45 N., R. 80 W.

A1—0 to 3 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; strong, very fine, granular structure; soft, very friable; mildly alkaline; clear, smooth boundary.

B1—3 to 5 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) moist; weak, medium, subangular blocky structure parting to moderate, very fine, granular; slightly hard, very friable; few, thin, patchy clay films on vertical ped faces; mildly alkaline; clear, smooth boundary.

B2t—5 to 9 inches, brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate, fine, prismatic structure parting to moderate, fine, subangular blocky; slightly hard, very friable; individual aggregates are hard; many, thin, patchy clay films on horizontal and vertical faces of soil aggregates; mildly alkaline; clear, wavy boundary.

B3ca—9 to 14 inches, light yellowish-brown (2.5Y 6/3) loam, light olive brown (2.5Y 5/3) moist; moderate, medium, subangular blocky structure; hard, very friable; few, thin, patchy clay films, mainly on vertical faces of soil aggregates; visible secondary calcium carbonate occurring as concretions and in thin seams and streaks; strong effervescence; moderately alkaline; gradual, wavy boundary.

C—14 inches, interbedded, calcareous shale and loamstone.

Depth to bedrock ranges from 10 to 20 inches, and depth to calcareous material ranges from 4 to 10 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent. The fragments are mainly shale.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 5 or 6 in value when dry or 3 or 4 when moist, and is 2 or 3 in chroma when dry or moist. Where the A1 horizon has a color value as dark as 5 when dry and 3 when moist, it is less than 5 inches thick. It is soft or slightly hard when dry. The A1 and B2t horizons are neutral or mildly alkaline.

The B2t horizon ranges from 2.5Y to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. It is generally clay loam that has a clay content ranging from 18 to 35 percent.

The Cca horizon, if present, ranges from 5Y to 10YR in hue. It is moderately alkaline or strongly alkaline.

Worf soils are mapped in associations with Briggsdale and Shingle soils.

Wormser Series

The Wormser series consists of sloping or moderately steep, well-drained soils. These soils formed in residuum weathered from shale on hillsides. Slopes range from 6 to 15 percent. Elevations range from 5,500 to 6,000 feet. The average annual precipitation is 12 to 14 inches, the average annual soil temperature is about 49° F., and the frost-free season is 95 to 110 days. The vegetation is western wheatgrass, green needlegrass, and big sagebrush.

In a representative profile the surface layer is grayish-brown, neutral silt loam about 3 inches thick. The subsoil is grayish-brown or brown, neutral or mildly alkaline clay loam about 16 inches thick. The substratum is grayish-brown, moderately alkaline clay loam, about 6 inches thick, that is underlain by shale bedrock at a depth of about 25 inches.

Permeability is moderately slow, and the available water capacity is moderate. The effective rooting depth is 20 to 40 inches.

These soils are used for range, as wildlife habitat, and in one area for dryland hay and small grain.

Representative profile of Wormser silt loam, in an area of Wormser-Shirk association, in the NW¼NE¼ sec. 16, T. 41 N., R. 81 W.

A1—0 to 3 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate to strong, very fine, granular structure; soft, very friable; neutral; clear, smooth boundary.

B1—3 to 6 inches, grayish-brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; weak to moderate, medium, prismatic structure parting to moderate, fine, subangular blocky; slightly hard, very friable; individual aggregates are hard; moderate, thin, patchy clay films on both horizontal and vertical faces of soil aggregates; neutral; clear, smooth boundary.

B2t—6 to 14 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate, medium, prismatic structure parting to moderate to strong, medium, subangular blocky; hard, very friable; individual aggregates are extremely hard; thin continuous clay films; mildly alkaline; clear, wavy boundary.

B3ca—14 to 19 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; weak to moderate, medium, subangular blocky structure; hard, friable; few, thin, patchy clay films on aggregate faces; calcium carbonate occurring as concretions and in thin seams and streaks; strong effervescence; mildly alkaline; gradual, wavy boundary.

C1ca—19 to 25 inches, grayish-brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; massive; hard, friable; visible secondary calcium carbonate occurring as concretions and in thin seams and streaks; violent effervescence; moderately alkaline; clear, wavy boundary.

C2—25 inches, shale bedrock.

Depth to bedrock ranges from 20 to 40 inches, and depth to calcareous material ranges from 12 to 18 inches. Content of coarse fragments ranges from 0 to 20 percent but typically increases as depth increases. The fragments are shale chips.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and ranges from 1 to 3 in chroma when dry or moist. It ranges from slightly acid to mildly alkaline.

The B2t horizon ranges from 2.5Y to 10YR in hue, is 4 or 5 in value when dry and 2 or 3 when moist, and is 2 or 3 in chroma when dry or moist. It is neutral or mildly alkaline. It is generally clay loam, but the content of clay ranges from 38 to 50 percent.

The B3ca and Cca horizons range from 2.5Y to 7.5YR in hue. They range from mildly alkaline to strongly alkaline. They are generally clay loam, but in some places they are channery clay loam.

Wormser-Englewood association (WE).—This association is about 50 percent Wormser silt loam, 6 to 15 percent slopes, and about 30 percent Englewood silty clay loam, 6 to 10 percent slopes. The Englewood soil has the profile described as representative of the Englewood series. These soils occupy hillsides and foot slopes. The Wormser soil is on hillsides on the upper parts of the landscape, and the Englewood soil is on foot slopes on the lower parts of the landscape.

Included with these soils in mapping are areas of Shirk soils that make up about 15 percent of the acreage and areas of Moret soils that make up about 5 percent.

Runoff is medium to rapid, and the hazard of erosion is moderate to high.

Soils of this association are used for range and wildlife habitat. (Capability unit VIe-1, dryland; Clayey range site, 10 to 14 inch precipitation zone)

Wormser-Shirk association (WM).—This association is about 45 percent Wormser silt loam, 6 to 15 percent slopes; about 25 percent Shirk clay loam, 10 to 20 percent slopes; and about 15 percent Moret clay loam, 10 to 30 percent slopes. These soils have the profiles described as representative of the Wormser and Shirk series. They occupy uplands and long hillsides, mainly on Tisdale Mountain in the south-central part of the survey area. The Wormser soil is on the lower hillsides, the Shirk soil is on the upper hillsides, and the Moret soil is on ridge crests and the shoulders of ridges.

Included with these soils in mapping are areas of Englewood soils that make up about 10 percent of the acreage and very shallow soils similar to this Moret soil that make up about 5 percent.

Runoff is medium to rapid on the Wormser soil and rapid on the Shirk and Moret soils. The hazard of erosion is moderate to high on the Wormser soil and high on the Shirk and Moret soils.

Soils of this association are used mainly for range and wildlife habitat, but small areas on the top of Tisdale Mountain are used for dryland hay and small grain. (Wormser soil in capability unit VIe–1, dryland, and Clayey range site, 10 to 14 inch precipitation zone. Shirk soil on capability unit VIe–2, dryland; Moret soil in capability unit VIIe–14, dryland. Shirk and Moret soils in Shallow Clayey range site, 10 to 14 inch precipitation zone)

Wyarno Series

The Wyarno series consists of nearly level to moderately steep, well-drained soils. These soils formed in alluvium derived from shale. They are on alluvial fans. Slopes range from 0 to 15 percent. Elevations range from 4,500 to 5,200 feet. The average annual precipitation is 11 to 13 inches, the average annual soil temperature is about 51° F., and the frost-free season is 105 to 120 days. The vegetation is western wheatgrass, green needlegrass, and big sagebrush.

In a representative profile the surface layer is grayish-brown, neutral clay loam about 4 inches thick. The upper part of the subsoil is brown, mildly alkaline clay about 6 inches thick, and the lower part is light olive-brown, moderately alkaline clay loam about 3 inches thick. The substratum is light olive-brown, moderately alkaline clay loam that reaches to a depth of 60 inches or more.

Permeability is moderately slow, and the available water capacity is high. The effective rooting depth is 60 inches or more.

These soils are used for range; for irrigated hay, pasture, and small grain; for dryland spring wheat and hay; and as wildlife habitat.

Representative profile of Wyarno clay loam, in an area of Wyarno-Limon association, in the NW¼NW¼ sec. 31, T. 46 N., R. 81 W.

A1—0 to 4 inches, grayish-brown (10YR 5/3) clay loam, dark grayish brown (10YR 4/2) moist; moderate, fine, granular structure; soft, very friable; many grass roots; neutral; gradual, smooth boundary.

B2t—4 to 10 inches, brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky; hard, friable, plastic; peds are extremely hard; thin, nearly continuous, waxlike coatings on ped faces and in root channels; mildly alkaline; clear, wavy boundary.

B3ca—10 to 13 inches, light olive-brown (2.5Y 5/3) clay loam, olive brown (2.5Y 4/3) moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky; very hard, very firm, very plastic; peds are extremely hard; few, thin, glossy patches on ped faces and inconsistent waxlike coatings in some root channels; some calcium carbonate accumulation occurring as soft concretions and in thin seams; slight effervescence; moderately alkaline; diffuse, wavy boundary.

Cca—13 to 60 inches, light olive-brown (2.5Y 5/4) clay loam, olive brown (2.5Y 4/4) moist; massive; very hard, very firm, plastic; continuous accumulation of secondary calcium carbonate occurring as soft concretions and in thin seams; strong effervescence; moderately alkaline.

Depth to calcareous material ranges from 6 to 12 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 10 percent.

The A1 horizon ranges from 2.5Y to 10YR in hue, is 5 or 6 in value when dry and 3 or 4 when moist, and is 2 or 3 in chroma when dry or moist. Where the A horizon has a color value as dark as 5 when dry and 3 when moist, it is less than 5 inches thick. In most places the primary structure is granular or crumb. This horizon is soft or slightly hard when dry. The A and B2t horizons are neutral or mildly alkaline.

The B2t horizon ranges from 2.5Y to 7.5YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. In most places the primary structure is prismatic, but in some places it is blocky or subangular blocky. Content of clay ranges from 35 to 50 percent.

The Cca horizon ranges from 2.5Y to 10YR in hue. It is moderately alkaline or strongly alkaline. It is generally clay loam, but in places it is clay.

Wyarno clay loam, 0 to 3 percent slopes (WnA).—This soil is on alluvial fans, mainly in stream valleys above flood plains. It has a profile similar to the one described as representative of the series, except that the surface layer ranges from silt loam to silty clay loam and is 6 inches thick. Most areas of this soil have a surface layer of clay loam.

Included with this soil in mapping are some areas of Limon, Heldt, and Ulm soils.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for irrigated hay, pasture, and small grain; for dryland small grain and hay; and for range. (Capability units IVs–1, dryland, and IIs–16, irrigated; Clayey range site, 10 to 14 inch precipitation zone)

Wyarno clay loam, 3 to 6 percent slopes (WnB).—This soil is on alluvial fans, in stream valleys, and in lower-lying areas adjacent to uplands. It has a profile similar to the one described as representative of the series, except that the surface layer is clay loam about 6 inches thick. The surface layer is silt loam or silty clay loam in some places but is clay loam in most places.

Included with this soil in mapping are areas of Heldt and Limon soils and small areas of Wyarno soils that have stronger slopes than 6 percent.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for irrigated hay, pasture, and small grain; for dryland spring wheat and hay; and for range. (Capability units IVe–1, dryland, and IIIe–1, irrigated; Clayey range site, 10 to 14 inch precipitation zone)

Wyarno-Limon association (WO).—This association is about 40 percent Wyarno clay loam, 0 to 6 percent slopes, and about 35 percent Limon silty clay, 0 to 6 percent

slopes. The Wyarno soil has the profile described as representative of the Wyarno series. These soils occupy alluvial fans. Generally, the Wyarno soil is at the lower end of the landscape, and the Limon soil is at the upper end of the landscape. In some areas, particularly along Fourmile Creek, the Absted and Stoneham soils that normally are inclusions occupy as much as 15 to 20 percent of the acreage.

Included with these soils in mapping are areas of Absted soils that make up about 10 percent of the acreage, areas of Stoneham soils that make up about 10 percent, and areas of Heldt soils that make up about 5 percent.

Runoff is slow to medium, and the hazard of erosion is slight to moderate.

Soils of this association are used for range and wildlife habitat. (Capability unit IVe-1, dryland; Clayey range site, 10 to 14 inch precipitation zone)

Wyarno-Stoneham association (WY).—This association is about 50 percent Wyarno clay loam, 6 to 10 percent slopes, and about 30 percent Stoneham sandy loam, 6 to 20 percent slopes. These soils occupy alluvial fans in valleys between upland ridges. The Wyarno soil is on the lower positions, and the Stoneham soil is on the upper positions, adjacent to uplands.

Included with these soils in mapping are areas of Ulm soils that make up about 10 percent of the acreage, areas of Ascalon soils that make up about 5 percent, and areas of Zigweid soils that make up about 5 percent.

Runoff is medium to rapid on Wyarno soil and medium to rapid on the Stoneham soil. The hazard of erosion is moderate to high on the Wyarno soil. The hazard of water erosion is moderate or high on the Stoneham soil, and if the cover is disturbed, the hazard of wind erosion is high.

Soils of this association are used for range and wildlife habitat. (Wyarno soil in capability unit VIe-1, dryland, and Clayey range site, 10 to 14 inch precipitation zone. Stoneham soil in capability unit VIe-2, dryland, and Loamy range site, 10 to 14 inch precipitation zone)

Zigweid Series

The Zigweid series consists of nearly level to moderately steep, well-drained soils. These soils formed in alluvium derived from sandstone and siltstone. They are on alluvial fans. Slopes range from 0 to 20 percent. Elevations range from 4,500 to 5,200 feet. The average annual precipitation is 11 to 12 inches, the average annual soil temperature is about 50° F., and the frost-free season is 100 to 115 days. The vegetation is western wheatgrass, threadleaf sedge, and blue grama.

In a representative profile the surface layer is light brownish-gray or grayish-brown, mildly alkaline loam about 6 inches thick. The subsoil is grayish-brown or light brownish-gray, moderately alkaline loam about 14 inches thick. The substratum is light brownish-gray or grayish-brown, moderately alkaline loam that reaches to a depth of 60 inches or more.

Permeability is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more.

These soils are used for range, as wildlife habitat, and to a minor extent for irrigated hay and small grain.

Representative profile of Zigweid loam, in an area of Kim-Zigweid association, moderately steep, near the west quarter corner of sec. 29, T. 44 N., R. 82 W.

A11—0 to 2 inches, light brownish-gray (2.5Y 6/2) loam, dark grayish brown (2.5Y 4/2) moist; weak, thin, platy structure parting to moderate, fine, crumb; soft, friable, slightly sticky and slightly plastic; mildly alkaline; clear, smooth boundary.

A12—2 to 6 inches, grayish-brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; moderate, medium, crumb structure; soft, friable, slightly sticky and slightly plastic; many roots; mildly alkaline; clear, smooth boundary.

B2—6 to 14 inches, grayish-brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; weak, medium, prismatic structure parting to moderate, medium, subangular blocky; slightly hard, friable, slightly sticky and slightly plastic; common roots; slight effervescence; moderately alkaline; clear, smooth boundary.

B3ca—14 to 20 inches, light brownish-gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; weak, coarse, subangular blocky structure; slightly hard, friable, sticky and slightly plastic; few roots; many fine seams and concretions of secondary calcium carbonate; strong effervescence; moderately alkaline; gradual, wavy boundary.

C1ca—20 to 36 inches, light brownish-gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many fine stams and concretions of secondary calcium carbonate; strong effervescence; moderately alkaline; gradual, wavy boundary.

C2ca—36 to 60 inches, grayish-brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many fine seams and concretions of secondary calcium carbonate; strong effervescence; moderately alkaline.

Depth to calcareous material ranges from 0 to 6 inches. Content of coarse fragments ranges from 0 to 15 percent but typically is less than 5 percent. These fragments are generally shale chips.

The A1 horizon ranges from 5Y to 10YR in hue, is 5 or 6 in value when dry and ranges from 3 to 5 when moist, and is 2 or 3 in chroma when dry or moist. Where the A1 horizon has a color value as dark as 5 when dry and 3 when moist, it is less than 5 inches thick. It is mildly alkaline or moderately alkaline. In most places the primary structure is crumb or granular, but in some places it is platy. This horizon is soft or slightly hard when dry.

The B2 horizon ranges from 5Y to 10YR in hue, is 5 or 6 in value when dry and 4 or 5 when moist, and ranges from 2 to 4 in chroma when dry or moist. In most places the primary structure is prismatic, but in some places it is subangular blocky. The B2 and B3ca horizons are generally loam, but the content of clay ranges from 18 to 35 percent. The B2 and C horizons are moderately alkaline or strongly alkaline.

The Cca horizon ranges from 5Y to 10YR in hue. In most places it has a few scattered crystals of calcium sulfate. It is generally loam, but the content of clay ranges from 18 to 35 percent.

Zigweid loam, 0 to 3 percent slopes (ZgA).—This soil is on alluvial fans. It has a profile similar to the one described as representative of the series, except that the surface layer is loam or clay loam.

Included with this soil in mapping are areas of Kim and Stoneham soils.

Runoff is slow, and the hazard of erosion is slight.

This soil is used for irrigated hay, pasture, and small grain. (Capability units IVe-2, dryland, and IIe-2, irrigated; Loamy range site, 10 to 14 inch precipitation zone)

Zigweid loam, 3 to 6 percent slopes (ZgB).—This soil is on alluvial fans. It has a profile similar to the one de-

scribed as representative of the series, except that the surface layer is loam or sandy clay loam.

Included with this soil in mapping are some areas of Kim and Stoneham soils.

Runoff is medium, and the hazard of erosion is moderate.

This soil is used for irrigated hay, pasture, and small grain. (Capability units IVe-2, dryland, and IIIe-2, irrigated; Loamy range site, 10 to 14 inch precipitation zone)

Zigweid-Keyner complex, hilly (ZKD).—This complex is about 40 percent Zigweid loam, 6 to 20 percent slopes, and about 30 percent Keyner loamy sand, 6 to 15 percent slopes. These soils are intermingled in a complex pattern. They are on foot slopes and alluvial fans, mainly at the base of upland ridges. In some areas where sandstone ledges occur above areaas of this complex, Embry soils make up 15 to 20 percent of the acreage.

Included with these soils in mapping are areas of Bone soils that make up about 15 percent of the acreage, areas of Keyner soils that have a surface layer of sandy loam 10 to 12 inches thick that make up about 10 percent, and areas of Gullied land that make up about 5 percent.

Runoff is medium to rapid, and the hazard of erosion is moderate to high. If the cover is destroyed, the hazard of wind erosion is high on the Keyner soil.

Soils of this complex are used for range and wildlife habitat. (Capability unit VIe-71, dryland; Loamy range site, 10 to 14 inch precipitation zone)

Use and Management of the Soils

This section describes the management of the soils for crops and pasture, explains the system of capability grouping used by the Soil Conservation Service, and outlines the management of soils in the survey area by capability units, both irrigated and dryland. Estimated yields of principal crops are shown. Also discussed is the management of soils for range, woodland, and wildlife habitat. The soil properties and features that affect engineering practices and the limitations that affect town and country planning are listed, mainly in tables.

Management of the Soils for Crops and Pasture [3]

The soils used for irrigated crops are on narrow bottom lands and alluvial fans along some of the streams. The crops are mainly hay and small grain grown for supplemental feed.

The only soils used for dryland crops are in a few areas around Ninemile Creek and Fourmile Creek and in a few places north of Kaycee. Spring wheat, hay, and pasture crops are grown. Less than 1 percent of the dryland area is used for dryland crops. Most of the area is used for range, woodland, and wildlife habitat.

Irrigation water.—The potential of irrigated soils for producing hay, pasture, and crops depends to a great extent on management of irrigation water. The quantity of water available for irrigation is dependent upon the amount of snow that accumulates in the Big Horn Mountains during winter. During a normal irrigation season the quantity of water is often not adequate late in July and in August. This risk has been eliminated on the irrigated land along the North Fork of Powder River by the installation of about 4,000 acre-feet of storage behind the Dull Knife Dam. Heavy thundershowers in summer also increase the late-season supply of water by raising the streams for short periods.

The principal supply of water comes from diversions out of the North Fork and Middle Fork of Powder River. These streams meander across many different geologic formations and drain areas of various soils. During periods of high runoff they carry a large load of sediment that ranges from red to dark gray, depending upon the origin of the material. The sediment load necessitates additional upkeep of main irrigation canals and laterals.

The quality of the irrigation water varies. Generally, the water along the Middle and North Forks of Powder River is of quality suitable for irrigation. Below the mouth of the South Fork of Powder River and below the mouth of Salt Creek, the Powder River has a high concentration of salt at low water level. This water in many places is not suitable for irrigation (*10*).

Capability grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The soils are grouped according to their limitations when used for field crops, the risk of damage when they are so used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for forest trees, or for engineering.

In the capability system, the kinds of soils are grouped at three levels: the capability class, the subclass, and the unit. These groups are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use.

Class I soils have few limitations that restrict their use. (None in Johnson County, Southern Part.)

Class II soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit

[3] ROBERT L. TRESLER, agronomist, Soil Conservation Service, helped prepare this section.

their use largely to pasture, range, woodland, or wildlife habitat. (None in Johnson County, Southern Part.)

Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture, range, woodland, or wildlife habitat.

Class VII soils have very severe limitations that make them unsuited to cultivation and restrict their use largely to pasture, range, woodland, or wildlife habitat.

Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife habitat, water supply, or esthetic purposes.

Capability Subclasses are soil groups within one class; they are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, although they have other limitations that restrict their use largely to pasture, range, woodland, wildlife habitat, or recreation.

Capability Units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIIe-1 or IVs-12. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

Management by capability units, irrigated

The average annual precipitation in irrigated areas of Johnson County, Southern Part, is 10 to 14 inches. The frost-free season is 95 to 120 days. Elevations range from 4,200 to 5,500 feet.

The potential for production of hay, pasture, and crops on the irrigated soils depends to a great extent upon water management. Practices needed to improve water management in the survey area are shaping of land by leveling or smoothing, installation of properly designed irrigation systems, and application of irrigation water to fit crop needs and soil conditions.

Many of the irrigated soils are erodible and conservation measures are needed. On most of the soils, grass hay, small grain, and pasture crops respond to application of nitrogen fertilizer. Some soils need phosphate fertilizer if the growth of alfalfa hay is to be satisfactory.

Many soils are suited to crops not presently grown in the survey area. For example, potatoes or sugar beets can be grown, but because a market is lacking, their production is not economical. Corn for silage has been grown experimentally in the survey area.

Some soils can be improved by drainage and removal of accumulated salts. Reestablishment of hay and pasture is needed in much of the irrigated area.

In the following pages each of the capability units, irrigated, in the survey area is described, and suggestions are made for use and management of the soils in each unit. The units are not numbered consecutively because not all the units in the Statewide system are represented in this survey area. The names of the soil series represented are mentioned in the descriptions of each unit, but this does not mean that all the soils in a given series are in the unit. The capability classification of each individual soil is given in the "Guide to Mapping Units."

CAPABILITY UNIT IIe-2, IRRIGATED

This capability unit consists of well-drained soils of the Fort Collins, Haverson, Kim, Stoneham, Ulm, and Zigweid series. These soils have a surface layer of loam or silt loam and a subsoil or underlying material of loam to clay loam. Slopes are 0 to 3 percent. Runoff is slow, and the hazard of erosion is slight. Permeability is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more. The seasonal high water table is below a depth of 60 inches. Precipitation is 10 to 14 inches, and the frost-free season is 100 to 120 days.

These soils are used for hay, pasture, and small grain. They are suitable for community development if soil management is good.

Practices that are applicable in conserving the soils of this unit are using a suitable cropping system, land leveling, and managing irrigation water.

CAPABILITY UNIT IIe-3, IRRIGATED

This capability unit consists of well-drained soils of the Barnum and Connerton series and the Barnum series, sandy subsoil variant. These soils are high in content of lime. They have a surface layer of silt loam and underlying layers of loam. Barnum silt loam, sandy subsoil variant, has fine sand below a depth of 24 inches. Slopes are 0 to 3 percent. Runoff is slow, the hazard of water erosion is moderate, and the hazard of wind erosion is high. Permeability is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more. The seasonal high water table is below a depth of 60 inches. Precipitation is 10 to 14 inches, and the frost-free season is 100 to 105 days.

These soils are used for hay, pasture, and small grain. They are suitable for community development if proper soil management is used.

Practices that are applicable in conserving the soils of this unit are using a suitable cropping system, land leveling, and managing irrigation water.

Because the soils contain a large amount of lime, legumes generally require larger than average applications of phosphate fertilizer.

CAPABILITY UNIT IIe-5, IRRIGATED

This capability unit consists only of Glenberg fine sandy loam. This is a well-drained soil that has a surface layer of fine sandy loam and underlying layers of sandy loam. Slopes are 0 to 3 percent. Runoff is slow, the hazard of water erosion is slight, and the hazard of wind erosion is high. Permeability is moderately rapid, and the available water capacity is moderate. The effective rooting depth is 60 inches or more. The seasonal high water table is below a depth of 60 inches. Precipitation is 10 to 12 inches, and the frost-free season is 110 to 120 days.

This soil is used for hay, pasture, and small grain. It is suitable for community development if proper soil management is used.

Practices that are applicable in conserving the soils of this unit are using a suitable cropping system, land leveling, and managing irrigation water.

CAPABILITY UNIT IIs-16, IRRIGATED

This capability unit consists of well-drained soils of the Haverson and Wyarno series. These soils have a surface layer of clay loam and underlying layers of clay loam to clay. Slopes are 0 to 3 percent. Runoff is slow, and the hazard of erosion is slight. Permeability is moderate to moderately slow, and the available water capacity is high. The effective rooting depth is 60 inches or more. The seasonal high water table is below a depth of 60 inches. Precipitation is 10 to 14 inches, and the frost-free season is 105 to 120 days.

These soils are used for hay, pasture, and small grain. They are suitable for community development if proper soil management is used.

Practices that are applicable in conserving the soils of this unit are using a suitable cropping system, land leveling, and managing irrigation water. Timely tillage and incorporation of crop residue and barnyard manure into the soil are needed to maintain good tilth, which is necessary for the good growth of crops.

CAPABILITY UNIT IIIe-1, IRRIGATED

This capability unit consists of well-drained soils of the Heldt, Limon, Rhoame, and Wyarno series. These soils have a surface layer of clay loam, silty clay loam, or silty clay. In most areas the subsoil or underlying material is clay or silty clay, but there is a small acreage in which the underlying material is channery clay loam. In this small acreage, the slopes are 0 to 6 percent, but generally the slopes are 3 to 6 percent. Runoff is slow, and the hazard of erosion is slight to moderate. Permeability is moderately slow to slow, and the available water capacity is high. The effective rooting depth is 50 to 60 inches or more. The precipitation is 10 to 13 inches, and the frost-free season is 95 to 120 days.

These soils are used for hay, pasture, and small grain.

Practices that are applicable in conserving the soils of this unit are using a suitable cropping system, land smoothing, and managing irrigation water. Uniform distribution of irrigation water is needed to control erosion. Timely tillage and the incorporation of crop residue and barnyard manure into the soil help to maintain good tilth, which is necessary for the good growth of crops. These soils take in water slowly, but the intake rate can be improved by using minimum tillage, by including long-term grasses and legumes in the cropping system, and by keeping the soils in good tilth.

CAPABILITY UNIT IIIe-2, IRRIGATED

This capability unit consists of well-drained soils of the Fort Collins, Harlan, Kim, Stoneham, Ulm, and Zigweid series. These soils have a surface layer of loam to silt loam and a subsoil or underlying material of loam to clay loam. Slopes are 3 to 6 percent. Runoff is medium, and the hazard of erosion is moderate. Permeability is moderate, and the available water capacity is high. The effective rooting depth is 40 to 60 inches or more. The precipitation is 10 to 14 inches, and the frost-free season is 95 to 120 days.

These soils are used for hay, pasture, and small grain. They are suitable for community development if proper soil management is used.

Practices that are applicable in conserving the soils of this unit are a suitable cropping system, land smoothing, and managing irrigation water. Uniform distribution of irrigation water is needed to control erosion.

CAPABILITY UNIT IIIe-3, IRRIGATED

This capability unit consists only of Connerton silt loam, 3 to 6 percent slopes. This is a well drained soil that has a high content of lime. It has a surface layer of silt loam and underlying layers of loam. Slopes are 3 to 6 percent. Runoff is medium, the hazard of water erosion is moderate to high, and the hazard of wind erosion is high. Permeability is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more. The precipitation is 10 to 14 inches, and the frost-free season is 100 to 105 days.

This soil is used for hay, pasture, and small grain. It is suitable for community development if proper soil management is used.

Practices that are applicable in conserving the soils of this unit are using a suitable cropping system, land smoothing, and managing irrigation water. Uniform distribution of irrigation water is needed to control erosion. Because the soil has a high content of lime, legumes generally require larger than average applications of phosphate fertilizer.

CAPABILITY UNIT IIIs-1, IRRIGATED

This capability unit consists of well drained and moderately well drained soils of the Heldt, Limon, and Lohmiller series. These soils have a surface layer of silty clay loam to silty clay and underlying layers of silty clay loam to clay. Slopes are 0 to 3 percent. Runoff is slow, and the hazard of erosion is slight. Permeability is slow, and the available water capacity is high. The effective rooting depth is 50 to 60 inches or more. The seasonal high water table is below a depth of 60 inches. The precipitation is 10 to 13 inches, and the frost-free season is 100 to 110 days.

These soils are used for hay, pasture, and small grain. They have severe limitations for community development.

Practices that are applicable in conserving the soils of this unit are using a suitable cropping system, land leveling, and managing irrigation water. Timely tillage and the incorporation of crop residue and barnyard manure into the soil help to maintain good tilth, which is necessary for the good growth of crops. These soils take in

water slowly, but the intake rate can be improved by using minimum tillage, by including long-term grasses and legumes in the cropping system, and by keeping the soils in good tilth.

CAPABILITY UNIT IIIs-5, IRRIGATED

This capability unit consists of well-drained soils of the Glenberg and Julesburg series. These soils have a surface layer and underlying layers of fine sandy loam. Sand is between depths of 30 and 60 inches or more. Slopes are 0 to 3 percent. Runoff is slow, the hazard of water erosion is slight, and the hazard of wind erosion is high. Permeability is moderately rapid, and the available water capacity is moderate. The effective rooting depth is 60 inches or more. The precipitation is 10 to 12 inches, and the frost-free season is 110 to 120 days.

These soils are used for hay, pasture, and small grain. They are suitable for community development.

Practices that are applicable in conserving the soils of this unit are using a suitable cropping system, land leveling, and managing irrigation water. Where this soil is leveled, care should be taken to avoid deep cuts that would expose the loose, sandy layers.

CAPABILITY UNT IVe-1, IRRIGATED

This capability unit consists of well-drained soils of the Heldt, Limon, and Rhoame series. These soils have a surface layer of silty clay to silty clay loam and underlying layers of channery clay to clay. Slopes are 6 to 10 percent. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Permeability is slow, and the available water capacity is high. The effective rooting depth is 50 to 60 inches or more. The precipitation is 10 to 13 inches, and the frost-free season is 95 to 110 days.

These soils are used for hay, pasture, and small grain. They are not good soils for community development.

Practices that are applicable in conserving the soils of this unit are using a suitable cropping system, land smoothing, and managing irrigation water. Uniform distribution of irrigation water through a properly designed system is essential for control of erosion. Timely tillage and the incorporation of crop residue and barnyard manure into the soil help to maintain good tilth, which is necessary for the good growth of crops. These soils take in water slowly, but the intake rate can be improved by using minimum tillage, by including long-term grass and legumes in the cropping system, and by keeping the soils in good tilth. Small grain can be grown where the soil is being prepared for the reestablishment of hay or pasture.

CAPABILITY UNIT IVe-2 IRRIGATED

This capability unit consists of well-drained soils of the Kim and Stoneham series. These soils have a surface layer of loam and a subsoil or underlying layers of loam to clay loam. Slopes are 6 to 10 percent. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Permeability is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more. The precipitation is 10 to 14 inches, and the frost-free season is 105 to 120 days.

These soils are used for hay, pasture, and small grain. They are suitable for community development if suitable soil management is used.

Practices that are applicable in conserving the soils of this unit are using a suitable cropping system, land smoothing, and managing irrigation water. Uniform distribution of irrigation water through a properly designed system is essential for control of erosion. Small grain should be grown where the soil is being prepared for reestablishment of hay or pasture.

CAPABILITY UNIT IVe-3, IRRIGATED

This capability unit consists only of Connerton silt loam, 6 to 10 percent slopes. This is a well-drained soil that is high in content of lime. It has a surface layer of silt loam and underlying layers of loam. Slopes are 6 to 10 percent. Runoff is rapid, and the hazards of water and wind erosion are high. Permeability is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more. The precipitation is 10 to 14 inches, and the frost-free season is 100 to 105 days.

This soil is used for hay, pasture, and small grain. It is suitable for community development if proper soil management is used.

Practices that are applicable in conserving the soil of this unit are using a suitable cropping system, land smoothing, and managing irrigation water. Uniform distribution of irrigation water through a properly designed system is essential for control of erosion. Because the soil contains a large amount of lime, legumes generally need larger than average applications of phosphate fertilizer. Small grain should be grown where land is being prepared for reestablishment of hay or pasture.

CAPABILITY UNIT IVs-12, IRRIGATED

This capability unit consists of moderately well drained soils of the Limon series. These soils have a surface layer and underlying layers of silty clay and are moderately saline to strongly saline. Slopes are 0 to 10 percent. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Permeability is slow, and the available water capacity is moderate. The effective rooting depth is 60 inches or more. The precipitation is 11 to 12 inches, and the frost-free season is 100 to 105 days.

These soils are used for hay and pasture. They have severe limitations for most community development.

Practices that are applicable in conserving the soils of this unit are managing hay and pasture, land smoothing, and managing irrigation water. Adapted hay and pasture species are limited to those that are moderately to strongly salt tolerant. Light, frequent applications of irrigation water help to minimize the effect of the salts, especially during establishment of the stand. The establishment of a good stand is difficult on these soils, and careful grazing management is needed to maintain the stand.

CAPABILITY UNIT IVs-15, IRRIGATED

This capability unit consists only of Bankard sand. This is a somewhat excessively drained soil that has a surface layer of sand and underlying layers of loamy fine sand or loamy sand. Slopes are 0 to 3 percent. Runoff is slow, the hazard of water erosion is slight, and the hazard of wind erosion is high. Permeability is rapid, and the available water capacity is low. The effective rooting depth is 60 inches or more. The seasonal high water table is at a depth of 60 inches or more. The precipitation

is 10 to 14 inches, and the frost-free season is 110 to 120 days.

This soil is used for hay, pasture, and small grain. It is suitable for community development.

Practices that are applicable in conserving the soils of this unit are using a suitable cropping system, land leveling, and managing irrigation water. Frequent irrigation is needed because the available water capacity is low. Because the hazard of wind erosion is high, this soil should not be left bare in fall and winter.

CAPABILITY UNIT IVws-10, IRRIGATED

This capability unit consists of poorly drained soils of the Connerton and Kim series. These soils are wet and saline, and it is difficult to drain them and leach them of salts. Slopes are 0 to 10 percent. Runoff is slow to rapid, and the hazard of water erosion is slight to high. The hazard of wind erosion is high on the Connerton soil. Permeability is moderate, and the available water capacity is moderate. The effective rooting depth is 60 inches or more. The water table is near the surface during part of the growing season, and the soil is moderately saline. The precipitation is 10 to 14 inches, and the frost-free season is 100 to 110 days.

These soils are used for pasture and hay. They are not suitable for community development.

Practices that are applicable in conserving the soils of this unit are managing hay and pasture, land smoothing, and managing irrigation water. Adapted hay and pasture species are limited to those that are moderately to strongly salt tolerant. Light, frequent applications of irrigation water help to minimize the effect of the salts and the high water table, especially during establishment of the stand. The establishment of a stand is difficult on these soils. Careful grazing management and maintenance of fertility are needed to maintain the stand and prevent invasion by undesirable plants.

CAPABILITY UNIT IVws-11, IRRIGATED

This capability unit consists only of Haverson silt loam, wet. This is a poorly drained, saline soil. Slopes are 0 to 3 percent. Runoff is slow, and the hazard of erosion is slight. Permeability is moderate, and the available water capacity is moderate. The effective rooting depth is 60 inches or more. This soil has a fluctuating water table that is near the surface during most of the growing season. It has moderate salinity. The precipitation is 10 to 14 inches, and the frost-free season is 105 to 120 days.

This soil is used for irrigated pasture. It is not suitable for community development unless subsurface drainage is provided and maintained.

Practices that are applicable in conserving the soil of this unit are managing pasture, land smoothing, managing irrigation water, and draining and reducing salt. Unless this soil is drained and the content of salts reduced, only salt-tolerant crops can be grown. Light, frequent applications of irrigation water help in establishing the stand.

CAPABILITY UNIT VIs-71, IRRIGATED

This capability unit consists of well-drained to poorly drained soils of the Absted, Keyner, and Petrie series and Saline, wet land. These soils have a surface layer of loamy sand to clay and a subsoil and underlying layers of variable texture. They are moderately alkaline to very strongly alkaline, and some of the soils in Saline, wet land are strongly saline. Slopes are 0 to 10 percent. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Permeability is moderately slow to slow, and the available water capacity is low to moderate. The effective rooting depth is 40 to 60 inches or more. The precipitation is 10 to 14 inches, and the frost-free season is 100 to 110 days.

These soils are used for grass, hay, and pasture. They are not suitable for community development.

Practices that are applicable in conserving the soils of this unit are managing hay and pasture, land smoothing, and managing irrigation water. The high content of sodium results in poor tilth, low water intake, and crusting. The incorporation of barnyard manure, other organic material, and gypsum into the soil helps in improving the surface condition and in establishing hay and pasture. Adapted hay and pasture plants are limited to those that are moderately to strongly alkali tolerant.

Management by capability units, dryland

Most of the nonirrigated areas in Johnson County, Southern Part, are used for range, woodland, and wildlife habitat. Less than 1 percent of the acreage is used for dryland crops, hay, or pasture. Suitability for dryland spring wheat, hay, or pasture is limited by lack of moisture, and these crops make poor growth in all but exceptionally wet years. Most of the production from dryfarming is used for livestock feed, but some spring wheat is sold as a cash crop. Low yields and frequent crop failures make growth of dryland small grain a marginal economic operation under existing conditions. Low moisture in fall generally limits the choice of wheat to spring wheat, which is grown in an alternate crop and fallow system. Dryland plantings for hay or pasture are limited to drought-tolerant species.

In the following pages each of the capability units, dryland, in Johnson County, Southern Part, is described, and suggestions are made for use and management of the soils in each unit. The units are not numbered consecutively because not all the units in the Statewide system are represented in this survey area. The names of the soil series represented are mentioned in the descriptions of each unit, but this does not mean that all the soils in a given series are in the unit. The capability classification of each individual soil is given in the "Guide to Mapping Units."

CAPABILITY UNIT IVe-1, DRYLAND

This capability unit consists of well-drained soils of the Heldt, Limon, Razor, Renohill, Rhoame, and Wyarno series. These soils have a surface layer of clay loam to silty clay and a subsoil or underlying material of channery clay to clay. Slopes are 0 to 10 percent. Runoff is slow to rapid, and the hazard of erosion is slight to high. Permeability is slow to moderately slow, and the available water capacity is low to high. The effective rooting depth is 20 to 60 inches or more. The precipitation is 10 to 13 inches, and the frost-free season is 90 to 120 days.

These soils are used for spring wheat and hay, range, and wildlife habitat. They have moderate to severe limitations for urban and recreational uses. They are suitable for irrigation development.

Practices that are applicable in conserving the soils of this unit are using a suitable cropping system, managing pasture and hay, stubble mulching, and terracing. Where spring wheat is grown, stubble mulching helps to control erosion and to improve the intake of water. Terraces are needed on the longer slopes to reduce losses of soil from water erosion.

CAPABILITY UNIT IVe-2, DRYLAND

This capability unit consists of well-drained soils of the Big Horn, Briggsdale, Fort Collins, Harlan, Haverson, Kim, Stoneham, Ulm, Wolf, and Zigweid series. These soils have a surface layer of sandy loam to clay loam and a subsoil or underlying layers of loam to clay. Some of these soils are underlain by shale at a depth of 20 to 40 inches. Slopes are 0 to 6 percent. Runoff is slow to medium, and the hazard of erosion is slight to moderate. Permeability is moderate to moderately slow, and the available water capacity is moderate to high. The effective rooting depth is 20 to 60 inches or more. The precipitation is 10 to 14 inches, and the frost-free season is 90 to 120 days.

These soils are used for spring wheat, range, and wildlife habitat. They are suitable for most community developments and for irrigation.

Practices that are applicable in conserving the soils of this unit are using a suitable cropping system, managing hay and pasture, stubble mulching, and terracing. Where spring wheat is grown, stubble-mulch fallowing helps to control erosion. Terraces are needed on some long slopes to reduce losses of soil from water erosion.

An Absted soil is also in this capability unit because it is mapped in a complex with a Stoneham soil. Its properties are such that, if mapped separately, this soil would be in another capability unit.

CAPABILITY UNIT IVe-3, DRYLAND

This capability unit consists of well-drained soils of the Barnum and Connerton series and the Barnum series, sandy subsoil variant. These soils are high in content of lime. They have a surface layer of very fine sandy loam or silt loam and underlying layers of loam. The Barnum soil, sandy subsoil variant, has a substratum of fine sand below a depth of 24 inches. Slopes are 0 to 6 percent. Runoff is slow to medium, the hazard of water erosion is moderate to high, and the hazard of wind erosion is high. Permeability is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more. The precipitation is 10 to 14 inches, and the frost-free season is 100 to 105 days.

These soils are used for range and wildlife habitat. They are suitable for irrigation, community development, and recreation.

CAPABILITY UNIT IVe-5, DRYLAND

This capability unit consists of well-drained soils of the Ascalon, Glenberg, Julesburg, Maysdorf, and Redbank series. These soils have a surface layer of sandy loam or fine sandy loam and a subsoil or underlying layers of sandy loam to sandy clay loam. They generally have slopes of 0 to 6 percent, but some of them have slopes of 6 to 10 percent. Runoff is slow to medium, the hazard of water erosion is slight to moderate, and the hazard of wind erosion is high. Permeability is moderate to moderately rapid, and the available water capacity is moderate to high. The effective rooting depth is 50 to 60 inches or more. The average annual precipitation is 10 to 14 inches, and the frost-free season is 95 to 120 days.

These soils are used for spring wheat, range, and wildlife habitat. Among the potential uses of these soils are irrigated crops, hay and pasture, and community development.

Practices that are applicable in conserving the soils of this unit are using a suitable cropping system, managing hay and pasture, and stubble mulching. If spring wheat is grown, stubble-mulch fallowing helps to control erosion.

CAPABILITY UNIT IVs-1, DRYLAND

This capability unit consists of well drained and moderately well drained soils of the Heldt, Limon, Lohmiller, and Wyarno series. These soils have a surface layer of clay loam to silty clay and a subsoil or underlying layer of silty clay loam to clay. Slopes are 0 to 3 percent. Runoff is slow, and the hazard of erosion is slight. Permeability is slow to moderately slow, and the available water capacity is high. The effective rooting depth is 50 to 60 inches or more. The precipitation is 10 to 13 inches, and the frost-free season is 100 to 120 days.

These soils are used for spring wheat, range, and wildlife habitat. Among the potential uses is irrigation. Slow permeability limits the use of these soils for community development.

Practices that are applicable in conserving the soils of this unit are using a suitable cropping system, managing hay or pasture, stubble mulching, and terracing. If spring wheat is grown, stubble-mulch fallowing helps to control erosion and to improve intake of water.

CAPABILITY UNIT VIe-1, DRYLAND

This capability unit consists of well-drained soils of the Englewood, Gaynor, Heldt, Limon, Razor, Renohill, Rhoame, Samsil, Turk, Wormser, and Wyarno series. These soils have a surface layer of loam to clay and a subsoil or underlying layers of clay loam to clay. Slopes are 6 to 20 percent. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Permeability is moderately slow to slow, and the available water capacity is low to high. The effective rooting depth is 20 to 60 inches or more. The precipitation is 10 to 19 inches, and the frost-free season is 60 to 120 days.

These soils are used for range and wildlife habitat. They are not suitable for dryland crops, but they respond to management as range or wildlife habitat. They are not well suited to community development.

CAPABILITY UNIT VIe-2, DRYLAND

This capability unit consists of well drained and moderately well drained soils of the Amsden, Auzqui, Bachus, Bayerton, Bidman, Briggsdale, Carnero, Cushman, Decross, Dell, Fort Collins, Gateson, Gystrum, Harlan, Kim, Kirtley, La Fonda, Leavitt, Lymanson, Passcreek, Pokeman, Potts, Rekop, Shirk, Slocum, Stoneham, Stubbs, Tripit, Ulm, Wetterhorn, Wolf, Woosley, and Zigweid series. These soils have a surface layer of sandy loam to clay loam and a subsoil or underlying material of loam to clay. Slopes are 6 to 30 percent. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Permeability is moderate to moderately slow, and the

available water capacity is low to high. The effective rooting depth is 20 to 60 inches or more. The Slocum soil is somewhat poorly drained and has a fluctuating water table at a depth of more than 30 inches. The precipitation is 10 to 19 inches, and the frost-free season is 60 to 120 days.

A Lohsman soil is also in this capability unit because it is mapped with a Briggsdale soil, and a Rekop soil because it is mapped with the Pokeman and Gystrum soils. Their properties are such that, if mapped separately, these soils would be in another capability unit.

These soils are used for range, woodland, watershed, and wildlife habitat. They are not suitable for dryland crops, but they respond to management as range, woodland, or wildlife habitat. Selected sites are suitable for community development. Soils of this unit that are in the mountains are suitable for recreation.

CAPABILITY UNIT VIe-3, DRYLAND

This capability unit consists of well-drained soils of the Connerton series. These soils are high in content of lime. They have a surface layer and underlying layers of loam to slit loam. Slopes are 3 to 30 percent. Runoff is medium to rapid, the hazard of water erosion is moderate to high, and the hazard of wind erosion is high. Permeability is moderate, and the available water capacity is high. The effective rooting depth is 60 inches or more. The precipitation is 10 to 14 inches, and the frost-free season is 100 to 105 days.

These soils are used for range and wildlife habitat. Selected sites are suitable for community development.

CAPABILITY UNIT VIe-5, DRYLAND

This capability unit consists of well-drained soils of the Ascalon, Burgess, Embry, Garrett, Indart, Julesburg, Mathers, Maysdorf, Otero, Pineguest, Poker, Pugsley, Sanford, Sawcreek, Slipman, Sublette, and Terry series. These soils have a surface layer of fine sandy loam to gravelly coarse sandy loam and a subsoil or underlying layers of sandy loam to sandy clay loam. Slopes are 6 to 30 percent. Runoff is medium to rapid, the hazard of water erosion is moderate to high, and the hazard of wind erosion is high. Permeability is moderate to moderately rapid, and the available water capacity is low to high. The effective rooting depth is 20 to 60 inches. The precipitation is 10 to 19 inches, and the frost-free season is 60 to 120 days.

These soils are used for range, watershed, woodland, and wildlife habitat. Selected sites are suitable for community development and for recreation. Irrigation is suitable where slopes are 6 to 10 percent, in areas below the mountains.

CAPABILITY UNIT VIe-15, DRYLAND

This capability unit consists of soils of the Bankard series and Alluvial land. These are somewhat excessively drained soils that have a surface layer of loamy sand or fine sand and underlying layers of loamy fine sand to loamy sand. Slopes are 0 to 3 percent. Runoff is slow, the hazard of water erosion is slight, and the hazard of wind erosion is high. Permeability is rapid, and the available water capacity is low. The effective rooting depth is 60 inches or more. The precipitation is 10 to 14 inches, and the frost-free season is 110 to 120 days.

These soils are used for range and wildlife habitat and in some areas as a source of sand. They are suitable for irrigation.

CAPABILITY UNIT VIe-71, DRYLAND

This capability unit consists of well-drained soils of the Absted, Cadoma, Keyner, Lohsman, and Orella series. These soils are very strongly alkaline beginning at a depth of 4 to 11 inches. Slopes are 3 to 15 percent. Runoff is slow to rapid, the hazard of water erosion is slight to high, and the hazard of wind erosion is high in most places. Permeability is moderately slow to slow, and the available water capacity is low to moderate. The effective rooting depth is 20 to 60 inches or more. The precipitation is 10 to 14 inches, and the frost-free season is 100 to 110 days.

These soils are used for range and wildlife habitat.

A Wyarno soil is also in this capability unit because it is mapped in a complex with an Absted soil and a Zigweid soil because it is mapped in a complex with a Keyner soil. Their properties are such that, if mapped separately, these soils would be in another capability unit.

CAPABILITY UNIT VIs-9, DRYLAND

This capability unit consists of well-drained, stony soils of the Cloud Peak and Nathrop series. Slopes are 6 to 30 percent. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Permeability is moderate, and the available water capacity is low to moderate. The effective rooting depth is 20 to 40 inches. The precipitation is 15 to 19 inches, and the frost-free season is 60 to 65 days.

These soils are used for range, woodland, watershed, and wildlife habitat. Their use is limited by stones or rocks. Among the potential uses of these soils is recreation.

CAPABILITY UNIT VIs-71, DRYLAND

This capability unit consists of well drained and moderately well drained soils of the Absted, Bone, Keyner, Limon, and Petrie series and Saline, wet land. These soils are very strongly alkaline beginning at a depth of ½ inch to 11 inches. Slopes are 0 to 10 percent. Runoff is slow to rapid, and the hazard of erosion is moderate to high. Permeability is slow to very slow, and the available water capacity is low to moderate. The effective rooting depth is 40 to 60 inches or more. The precipitation is 10 to 14 inches, and the frost-free season is 100 to 120 days.

These soils are used for range and wildlife habitat. They are not suitable for roadbeds of highways or for community development.

A Wyarno soil is also in this capability unit because it is mapped in a complex with an Absted soil. Its properties are such that, if mapped separately, this soil would be in another capability unit.

CAPABILITY UNIT VIws-10, DRYLAND

This capability unit consists of poorly drained soils of the Connerton and Kim series. These soils are wet and saline, and they are difficult to drain. Slopes are 0 to 10 percent. Runoff is slow to rapid, and the hazard of water erosion is slight to high. The hazard of wind erosion is high on the Connerton soil. Permeability is moderate, and the available water capacity is moderate. The soil is wet to the surface during most of the growing season. The effective rooting depth is 60 inches or more. These soils

have a moderate accumulation of soluble salts. The precipitation is 10 to 14 inches, and the frost-free season is 100 to 110 days.

These soils are used for range and wildlife habitat. They are not suitable for building sites or community development. If they are used for irrigated forage, intensive management is needed.

CAPABILITY UNIT VIws-11 DRYLAND

This capability unit consists of somewhat poorly drained or poorly drained soils of the Haverson and Glenberg series. These soils are saline, but they are suitable for drainage. Slopes are 0 to 3 percent. Runoff is slow, and the hazard of erosion is generally slight. The hazard of wind erosion is high on the Glenberg soil. Permeability is moderate to moderately rapid, and the available water capacity is moderate. The effective rooting depth is 60 inches or more. These soils have a fluctuating water table and low to moderate salinity. The precipitation is 10 to 14 inches, and the frost-free season is 105 to 120 days.

These soils are used for range and wildlife habitat. If adequately drained, they are suitable for some urban and recreational uses. They are also suited to irrigated hay, pasture, and small grain.

CAPABILITY UNIT VIIe-14, DRYLAND

This capability unit consists of well-drained to excessively drained, shallow and very shallow soils of the Cragola, Danko, Devoe, Hazton, Jenkinson, Moret, Samsil, Schooner, Shingle, Southfork, Spearfish, Splitro, Starley, Sunup, Tassel, Tolman, Travessilla, and Worf series. Depth to bedrock is 8 to 20 inches. Slopes are 3 to 40 percent. Runoff is medium to rapid, and the hazard of erosion is moderate to high. Permeability is slow to rapid, and the available water capacity is low. The effective rooting depth is 8 to 20 inches. The precipitation is 10 to 19 inches, and the frost-free season is 60 to 120 days.

These soils are used for range, watershed, and wildlife habitat. Among the potential uses is recreation.

Other soils also in this capability unit are a Cadoma soil because it is mapped in a complex with a Samsil soil; a Gaynor soil because it is mapped in a complex with a Samsil soil; a Pugsley soil because it is mapped in a complex with the Southfork soil; a Rencalson soil because it is mapped in a complex with a Moret soil; a Rhoame soil because it is mapped in a complex with a Moret soil; Rock land because it is mapped in complexes with Devoe and Moret soils; Rock outcrop because it is mapped in complexes with Starley, Sunup, and Travessilla soils; and Shale outcrop because it is mapped in complexes with Samsil and Spearfish soils. Their properties are such that, if mapped separately, these soils would be in a different capability unit.

CAPABILITY UNIT VIIe-15, DRYLAND

This capability unit consists only of the Valent part of the Valent-Cushman association. This soil has a surface layer of loamy sand and is underlain by fine sand. Slopes are 6 to 20 percent. Runoff is slow to medium, the hazard of water erosion is slight to moderate, and the hazard of wind erosion is high. Permeability is rapid, and the available water capacity is low. The effective rooting depth is 60 inches or more. The precipitation is 10 to 12 inches, and the frost-free season is 105 to 120 days.

This soil is used for range and wildlife habitat and, in some areas, as a source of sand.

CAPABILITY UNIT VIIs-9, DRYLAND

This capability unit consists of well-drained to excessively drained soils of the Simmont series and Colluvial land. These soils have a surface layer of sandy loam and a subsoil of very cobbly sandy clay loam. Colluvial land is made up of steep to very steep deposits of rock fragments and soil material, and Rock outcrop is in barren areas. Slopes are 15 to 40 percent. Runoff is rapid, and the hazard of erosion is high. Permeability is moderate, and the available water capacity is low to moderate. The effective rooting depth is 20 to 40 inches. The precipitation is 13 to 14 inches, and the frost-free season is 85 to 90 days.

These soils are used for woodland and wildlife habitat. They also have a potential for recreation.

Rock outcrop is also in this capability unit because it is mapped in a complex with the Simmont soil. Its properties are such that, if mapped separately, this land type would be in a different capability unit.

CAPABILITY UNIT VIIIe-82, DRYLAND

This capability unit consists of Badland, a nearly barren land type; and Gullied land, a land type that is made up of actively eroding gullies. These land types are used for wildlife habitat.

CAPABILITY UNIT VIIIs-83, DRYLAND

This capability unit consists of Rock land, Shale outcrop, and Shale rock land. These land types are mainly steep to very steep. They are used mainly for wildlife habitat and recreation. Bentonite is mined in areas of Shale outcrop.

Estimated yields

Table 2 shows the estimated yields of the principal crops that are irrigated, dryland, or both. These yields can be obtained in Johnson County, Southern Part, under a high level of management. The estimates are based on observations of soil scientists who surveyed the survey area, on information contained in the records of farmers and ranchers in the survey area, and from data obtained from the agricultural agent and the Agricultural Stabilization and Conservation Service. Soils that generally are not used or not suited to irrigated crops or dryland crops are not included in the table.

Under irrigation, alfalfa-hay generally is grown for 5 to 6 years, followed by 2 to 3 years of small grain. Corn for silage has been produced in the Barnum area, as well as in the Sussex area, and replaces small grain in the rotation. Increasing amounts of commercial fertilizer are used in the irrigated area. Irrigation water generally is adequate until about the middle of July. The hay crops generally are irrigated twice by contour-ditch systems, border ditches, or border dikes. Small grain also is irrigated twice by the same kinds of systems.

In dryland areas a system of alternate fallowing and cropping is used. The management generally consists of stubble-mulch tillage during the fallow year and the seed-

TABLE 2.—*Estimated average yields per acre under a high level of management*

[Soils that are not used for crops or not suited to them are not listed in this table]

Soil name	Alfalfa, irrigated	Barley, irrigated	Corn for silage, irrigated	Oats, irrigated	Grass for hay		Pasture		Spring wheat, dryland [1]
					Irrigated	Dryland	Irrigated	Dryland	
	Tons	*Bu.*	*Tons*	*Bu.*	*Tons*	*Tons*	*AUM* [2]	*AUM* [2]	*Bu.*
Absted clay	---	---	---	---	1.0	0.5	3	---	10
Bankard sand	2.0	40	---	50	1.0	.5	3	---	
Barnum silt loam	5.0	60	18	80	2.5	---	6	---	---
Barnum silt loam, sandy subsoil variant	5.0	60	18	80	2.5	---	6	---	---
Briggsdale sandy loam, 0 to 6 percent slopes	---	---	---	---	---	.5	---	0.75	18
Briggsdale sandy loam, 6 to 10 percent slopes	---	---	---	---	---	.5	---	.5	15
Connerton silt loam, 0 to 3 percent slopes	5.0	70	18	85	2.5	---	6	.75	---
Connerton silt loam, 3 to 6 percent slopes	5.0	70	18	85	2.5	---	6	.5	---
Connerton silt loam, 6 to 10 percent slopes	3.0	50	---	60	2.0	---	4	.5	---
Connerton silt loam, wet	---	20	---	---	2.0	---	4	.5	---
Fort Collins loam, 0 to 3 percent slopes	5.0	60	18	80	2.5	1.0	6	.75	20
Fort Collins loam, 3 to 6 percent slopes	5.0	60	18	80	2.5	1.0	6	.75	20
Glenberg fine sandy loam	4.0	70	15	80	2.0	---	5	.5	---
Glenberg fine sandy loam, sand substratum	3.0	50	15	60	2.0	---	4	.5	---
Harlan silt loam	4.0	55	---	70	2.5	---	6	.75	---
Haverson clay loam	4.0	60	18	80	2.5	---	6	.75	---
Haverson silt loam	5.0	60	18	80	2.5	---	6	.75	---
Haverson silt loam, sandy subsoil variant	4.0	55	15	70	2.0	---	5	.5	---
Haverson silt loam, wet	---	---	---	---	2.0	---	4	.5	---
Heldt silty clay loam, 0 to 3 percent slopes	3.5	55	---	70	2.0	---	5	.5	---
Heldt silty clay loam, 3 to 6 percent slopes	3.5	55	---	70	2.0	---	5	.5	---
Heldt silty clay loam, 6 to 10 percent slopes	3.0	45	---	60	1.75	---	4	.5	---
Julesburg fine sandy loam	5.0	70	---	80	2.5	---	5	---	---
Kim loam, 0 to 3 percent slopes	4.0	60	---	80	2.0	---	6	.75	---
Kim loam, 3 to 6 percent slopes	4.0	50	---	70	2.0	---	6	.75	---
Kim loam, 6 to 10 percent slopes	3.0	50	---	60	1.5	---	4	.5	---
Kim loam, wet	---	40	---	---	2.0	---	4	.5	---
Limon silty clay, 0 to 3 percent slopes	3.0	55	---	70	2.0	.5	5	.5	15
Limon silty clay, 3 to 6 percent slopes	3.0	55	---	70	2.0	.5	5	.5	15
Limon silty clay, 6 to 10 percent slopes	2.5	50	---	60	1.5	---	4	.5	---
Limon silty clay, saline, 0 to 6 percent slopes	---	---	---	---	1.5	---	4	.5	---
Limon silty clay, saline, 6 to 10 percent slopes	---	---	---	---	1.5	---	3	.33	---
Lohmiller silty clay loam	3.0	55	---	65	2.0	---	5	.5	---
Maysdorf sandy loam, 0 to 6 percent slopes	3.0	55	---	70	2.0	1.0	5	.5	18
Maysdorf sandy loam, 6 to 10 percent slopes	2.5	50	---	60	1.5	.5	4	.5	12
Petrie silty clay	---	---	---	---	.5	---	2	---	---
Renohill clay loam, 0 to 6 percent slopes	---	---	---	---	---	.5	---	.5	15
Renohill clay loam, 6 to 14 percent slopes	---	---	---	---	---	.5	---	.33	12
Rhoame silty clay, 0 to 6 percent slopes	3.0	55	---	70	2.0	.75	5	.75	12
Rhoame silty clay, 6 to 10 percent slopes	2.5	50	---	60	1.5	.5	4	.5	---
Shingle clay loam	---	---	---	---	---	---	---	.25	8
Stoneham loam, 0 to 3 percent slopes	5.0	60	18	80	2.0	.75	6	.75	20
Stoneham loam, 3 to 6 percent slopes	4.0	55	---	70	2.0	.75	5	.75	18
Stoneham loam, 6 to 10 percent slopes	3.0	50	---	60	2.0	---	4	.5	12

See footnotes at end of table.

TABLE 2. *Estimated average yields per acre under a high level of management*—Continued

Soil name	Alfalfa, irrigated	Barley, irrigated	Corn for silage, irrigated	Oats, irrigated	Grass for hay: Irrigated	Grass for hay: Dryland	Pasture: Irrigated	Pasture: Dryland	Spring wheat dryland[1]
	Tons	*Bu.*	*Tons*	*Bu.*	*Tons*	*Tons*	*AMU*[2]	*AMU*[2]	*Bu.*
Ulm loam, 0 to 3 percent slopes	4.5	60	----------	80	2.0	0.75	6	0.75	18
Ulm loam, 3 to 6 percent slopes	3.0	55	----------	70	2.0	.5	4	.5	18
Wyarno clay loam, 0 to 3 percent slopes	3.5	60	----------	80	2.0	.5	6	.5	15
Wyarno clay loam, 3 to 6 percent slopes	3.0	55	----------	70	2.0	.5	5	.5	15
Zigweid loam, 0 to 3 percent slopes	5.0	60	----------	80	2.0	.75	6	.75	--------
Zigweid loam, 3 to 6 percent slopes	3.0	55	----------	70	2.0	.5	5	.5	--------

[1] Yields of dryland spring wheat are based on a crop rotation consisting of 1 year of fallow and 1 year of crop.

[2] Animal-unit-months indicate the amount of forage required by 1 animal unit (1,000 pounds live weight) for 1 month. This represents the number of months the pasture can be grazed multiplied by the number of animal units an acre will support without injury to the vegetation resource. An acre of pasture that can provide grazing for 4 animals for 2 months has a stocking rate of 8 animal-unit-months.

ing of spring wheat early in spring. The seeding of winter wheat in fall has not proved successful.

Current recommended varieties of crops are used for seeding.

Management for Range[4]

About 1,131,177 acres in the southern part of Johnson County is range, and an additional 9,784 acres is used for range and woodland. The range areas are large blocks of land where areas that are irrigated and areas that are dryland are intermingled. On the face of and on top of the mountain, range is intermingled with woodland.

Most of the range is grazed in spring, summer, and fall, but some areas, particularly those east of Powder River, are grazed the year round. Many livestock operators have summer range in the Big Horn Mountains, on private, State, or Federal lands. These grazing areas are used in summer from about the middle of June until the middle of September. Additional grazing is provided in fall on the stubble of dryland wheatfields and on the stubble of small grain and on hay meadows in irrigated areas.

Table 3 shows production data obtained from the clipping of range plots. These data were obtained in 1968 and 1969 from a study of soils on various range sites throughout the survey area. Estimated production is shown for both favorable and unfavorable years. Key soils were selected within certain range sites in areas that had limited or no grazing. The plants in the selected plots were identified and the plots clipped, and the results were converted to pounds per acre of air-dry herbage. The size of each plot was 1.96 square feet. The pounds of air-dry herbage reported here varies somewhat from the estimated yields given in the description of each range site. The difference is due to the short study period and to the fact that no true relict areas were located for the studies.

[4] CHARLES C. MCAFEE, range conservationist, Soil Conservation Service, Sheridan, Wyoming, helped prepare this section.

Range sites and condition classes

Different kinds of soil vary in their capacity to produce grass and other plants for grazing. Soils that produce about the same kinds and amounts of forage make up a range site.

Range sites differ in their ability to produce vegetation. The soils of any one range site produce about the same kind of climax vegetation. Climax vegetation is the stabilized plant community; it reproduces itself and does not change so long as the environment remains unchanged. It has been growing throughout the prairies and the plains since they were first settled. If cultivated crops are not grown, the most productive combination of forage plants on a range site generally is the climax vegetation.

Decreasers are plants in the climax vegetation that tend to decrease in relative amount under close grazing. They generally are the tallest and most productive perennial grasses and forbs and the most palatable to livestock.

Increasers are plants in the climax vegetation that increase in relative amount as the more desirable decreaser plants are reduced by close grazing. They commonly are shorter than decreasers and generally are less palatable to livestock.

Invaders are plants that cannot compete with plants in the climax plant community for moisture, nutrients, and light. Where the climax vegetation has been reduced by grazing, invaders grow along with increasers. Many invaders are annual weeds, and some are shrubs that have some grazing value, but others have little value for grazing.

Range condition is rated by comparing the composition of the existing plant community that has been brought about by grazing or other uses with that of the potential or climax vegetation. Such a rating is useful since an

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TABLE 3.—*Measured yields of air-dry herbage on selected soils*

[Yield data are for the period 1968 and 1969]

Soil	Range site	Condition class	Average annual precipitation	Air-dry herbage in— Favorable growing season	Unfavorable growing season
			Inches	*Pounds per acre*	*Pounds per acre*
Big Horn loam	Clayey	Good	14	1,020	398
	Clayey	Excellent	14	[1] 1,996	763
	Clayey	Excellent	14	[2] 992	497
Briggsdale very fine sandy loam.	Loamy	Good	12	1,250	653
Connerton loam	Loamy	Excellent	13	1,083	576
Decross loam	Loamy	Excellent	18	1,901	829
Gaynor silty clay.	Clayey	Excellent	13	873	585
Haverson loam	Lowland.	Excellent	13	3,423	-------
Maysdorf sandy loam.	Loamy	Good	12	720	495
Moret clay loam.	Shallow clayey.	Excellent	13	795	385
Renohill clay loam.	Clayey	Excellent	12	1,097	462
Samsil silty clay.	Shallow clayey.	Excellent	13	1,000	484
Spearfish very fine sandy loam.	Shallow loamy.	Excellent	13	766	356
Wolf loam	Loamy	Good	14	1,367	501
Woosley loam	Loamy	Excellent	18	1,715	678

[1] 67 percent of composition is green needlegrass.
[2] 13 percent of composition is green needlegrass.

estimate of the deterioration that has taken place indicates the degree of improvement possible.

A range site is in excellent condition if 76 to 100 percent of the existing vegetation is of the same composition as that in the climax stand. It is in good condition if the percentage is 51 to 75; in fair condition if the percentage is 26 to 50; and in poor condition if the percentage is less than 25.

Potential forage production depends on the range site. Current forage production depends on the range condition and the moisture available to plants during the growing season.

A primary objective of good range management is to keep range in excellent or good condition. If this is done, water is conserved, yields are improved, and the soils are protected. It is necessary to recognize important changes in the kind and composition of cover on a range site. These changes take place gradually and can be misinterpreted or overlooked. Growth encouraged by heavy rainfall can lead to the conclusion that the range is in good condition, when actually the cover is weedy and the long-term trend is toward lower production. On the other hand, some range areas that have been closely grazed for short periods, under careful management, can have a degraded appearance that temporarily conceals their quality and ability to recover.

Descriptions of range sites

The range sites in Johnson County, Southern Part, are described in this section. The description of each range site explains the important characteristics of the climate and of the soils, the principal range plants, and information about how to use and manage the vegetation.

The soils of the survey area that produce similar kinds and amounts of vegetation have been grouped into 22 range sites. The description of each range site includes estimates of potential annual yield that can be expected if the range site is in excellent condition. These yields represent the total air-dry weight of herbage, which is made up of seeds, leaves, and stems.

In this survey area the following land types are not assigned to any range site: Badland, Colluvial land, Gullied land, Rock land, Rock outcrop, Shale outcrop, and Shale rock land. To find the range site associated with any given soil, refer to the "Guide to Mapping Units."

CLAYEY RANGE SITE, 10 TO 14 INCH PRECIPITATION ZONE

This range site consists of well-drained soils of the Absted, Big Horn, Englewood, Gaynor, Heldt, Limon, Razor, Rencalson, Renohill, Rhoame, Wormser, and Wyarno series. These soils have a surface layer of loam to silty clay and, generally, a subsoil or underlying layers of clay loam, silty clay, or clay. Slopes are 0 to 20 percent. Permeability is moderately slow to slow, and the available water capacity is low to high. The precipitation is 10 to 14 inches.

The climax vegetation is about 60 percent western wheatgrass, thickspike wheatgrass, green needlegrass, Cusick bluegrass, American vetch, prairieclover, and winterfat and about 40 percent blue grama, plains reedgrass, prairie junegrass, needleleaf sedge, Sandberg bluegrass, aster, biscuitroot, western yarrow, milkvetch, and big sagebrush. If range condition declines, big sagebrush, short grasses, and invading plants generally become dominant. The principal invaders are annuals, curlycup gumweed, and foxtail barley.

Among the practices that apply to this site are proper grazing use, deferred grazing, and a planned system of grazing. Other practices that can be used in most areas are range seeding, the mechanical treatment of grazing land, brush control, water spreading, and the development of stock water.

If this site is in excellent condition, the estimated annual yield per acre of air-dry herbage ranges from 1,800 pounds in favorable years to 750 pounds in unfavorable years. About 85 to 90 percent of this production is plants that furnish forage for cattle, sheep, horses, and wildlife.

CLAYEY OVERFLOW RANGE SITE, 10 TO 14 INCH PRECIPITATION ZONE

This range site consists of well drained to moderately well drained soils of the Haverson and Lohmiller series. These soils receive overflow from streams or adjacent uplands. Their surface layer and underlying material are clay loam to silty clay loam. Slopes are 0 to 3 per-

cent. Permeability is moderate to slow, and the available water capacity is high. The seasonal high water table is below a depth of 40 inches. The precipitation is 10 to 14 inches.

The climax vegetation is about 45 percent basin wildrye, green needlegrass, Cusick bluegrass, winterfat, and American vetch and about 55 percent western wheatgrass, Sandberg bluegrass, prairie junegrass, American licorice, western yarrow, aster, twogrooved milkvetch, and Hoods phlox. If range condition declines, short grasses and invading plants generally become dominant. The principal invaders are curlycup gumweed, foxtail barley, and annuals.

Among the practices that apply to this site are proper grazing use, deferred grazing, and a planned system of grazing. Other practices that can be used in most areas are water spreading and the development of stock water.

If this soil is in excellent condition, the estimated annual yield per acre of air-dry herbage ranges from about 2,800 pounds in favorable years to 1,900 pounds in unfavorable years. About 85 to 90 percent of this production is plants that furnish forage for cattle, sheep, horses, and wildlife.

DENSE CLAY RANGE SITE, 10 TO 14 INCH PRECIPITATION ZONE

This range site consists of well-drained to somewhat poorly drained soils of the Bone, Cadoma, and Orella series. These soils generally have a surface layer of clay to silty clay loam and are underlain by alkaline clay and silty clay, but the Bone soils have a very thin surface layer of loam. Slopes are 0 to 30 percent. Permeability is very slow, and the available water capacity is low to moderate. These soils are very strongly alkaline at or near the surface and to a depth of 16 inches or more.

The climax vegetation is about 65 percent green needlegrass, thickspike wheatgrass, western wheatgrass, Montana wheatgrass, and winterfat and about 35 percent Sandberg bluegrass, squirreltail, plains reedgrass, needleleaf sedge, onion, biscuitroot, wood aster, birdfoot sagebrush, and big sagebrush. If range condition declines, big sagebrush, birdfoot sagebrush, and invading plants generally become dominant. The principal invaders are annuals and curlycup gumweed.

Among the practices that apply to this site are proper grazing use, deferred grazing, and a planned system of grazing. Other practices that can be used in most areas are mechanical treatment of grazing land and the development of stock water.

If this site is in excellent condition, the estimated annual yield per acre of air-dry herbage ranges from about 1,200 pounds in favorable years to 450 pounds in unfavorable years. About 70 percent of this production is plants that furnish forage for cattle, sheep, horses, and wildlife.

LOAMY RANGE SITE, 10 TO 14 INCH PRECIPITATION ZONE

This range site consists of well-drained soils of the Absted, Ascalon, Bidman, Briggsdale, Carnero, Connerton, Cushman, Fort Collins, Garret, Gystrum, Harlan, Keyner, Kim, Kirtley, La Fonda, Lohsman, Maysdorf, Pokeman, Potts, Pugsley, Stoneham, Ulm, Wolf, and Zigweid series. These soils generally have a loamy surface layer, subsoil, or underlying material, except that the Keyner soils have a surface layer of loamy sand and the Absted and Lohsman soils have a subsoil of clay. Slopes are 0 to 30 percent. Permeability is moderately rapid to moderately slow, and the available water capacity is low to high. The precipitation is 10 to 14 inches.

The climax vegetation is about 50 percent western wheatgrass, thickspike wheatgrass, green needlegrass, Indian ricegrass, American vetch, winterfat, and prairieclover and about 50 percent needle-and-thread, blue grama, Sandberg bluegrass, prairie junegrass, threadwort, silverleaf scurfpea, locoweed, and Hoods phlox. If range condition declines, big sagebrush, short grasses, and invading plants generally become dominant. The principal invaders are annuals, curlycup gumweed, foxtail barley, and cactus.

Among the practices that apply to this site are seeding, control of brush, proper grazing use, deferred grazing, a planned system of grazing, mechanical treatment of grazing land, and the development of stock water. Water spreading is suitable on some of the lower slopes.

If this site is in excellent condition, the estimated annual yield per acre of air-dry herbage ranges from about 1,500 pounds in favorable years to 850 pounds in unfavorable years. About 90 percent of this production is plants that furnish forage for cattle, sheep, horses, and wildlife.

LOWLAND RANGE SITE, 10 TO 14 INCH PRECIPITATION ZONE

This range site consists of well-drained soils of the Barnum, Glenberg, Haverson, and Redbank series as well as the sandy subsoil variants of the Barnum and Haverson series. These soils have a fluctuating water table that is within the reach of deeper rooted plants. These soils have a surface layer and underlying material of sandy loam to silt loam. Slopes are 0 to 3 percent. Permeability is moderate to moderately rapid, and the available water capacity is moderate to high. The seasonal high water table is below a depth of 40 inches, but the soil is moist above a depth of 40 inches during part of the growing season. The precipitation is 12 to 13 inches.

The climax vegetation is about 50 percent basin wildrye, Canada wildrye, slender wheatgrass, green needlegrass, and purple prairieclover and about 50 percent western wheatgrass, needle-and-thread, prairie junegrass, Sandberg bluegrass, American licorice, fringed sagewort, snowberry, cottonwood, and silver sagebrush. If range condition declines, woody plants generally become dominant.

Among the practices that apply to this site are proper grazing use, deferred grazing, and a planned system of grazing. Other practices that can be used include brush control.

If this site is in excellent condition, the estimated annual yield per acre of air-dry herbage ranges from about 3,000 pounds in favorable years to 2,000 pounds in unfavorable years. About 75 to 80 percent of this production is plants that furnish forage for cattle, sheep, horses, and wildlife.

OVERFLOW RANGE SITE, 10 TO 14 INCH PRECIPITATION ZONE

This range site consists of well-drained soils of the Glenberg, Haverson, and Kim series. These soils receive overflow from streams or adjacent uplands. They have a surface layer and underlying layers of loam and sandy loam. Slopes are 0 to 10 percent. Permeability is moderate to moderately rapid, and the available water capacity is moderate to high. The seasonal high water table is below a depth of 40 inches. The precipitation is 10 to 14 inches.

The climax vegetation is about 45 percent basin wildrye, green needlegrass, Cusick bluegrass, Canada wildrye, winterfat, American vetch, and prairieclover and about 55 percent western wheatgrass, needle-and-thread, Sandberg bluegrass, blue grama, prairie junegrass, threadleaf sedge, American licorice, aster, fleabane, western yarrow, and silver sagebrush. If range condition declines, silver sagebrush and invading plants generally become dominant. The principal invaders are annuals, foxtail barley, and curlycup gumweed.

Among the practices that apply to this site are proper grazing use, deferred grazing, and a planned system of grazing. Other practices that can be used in most areas are water spreading, brush control, and the development of stock water.

If this site is in excellent condition, the estimated annual yield per acre of air-dry herbage ranges from about 3,000 pounds in favorable years to 2,000 pounds in unfavorable years. About 85 to 90 percent of this production is plants that furnish forage for cattle, sheep, horses, and wildlife.

SALINE LOWLAND RANGE SITE, 10 TO 14 INCH PRECIPITATION ZONE

This range site consists of moderately well drained to well drained soils of the Limon and Petrie series. These soils have a surface layer of silty clay and underlying layers of silty clay to clay. They receive overflow from adjacent areas. Slopes are 0 to 10 percent. Permeability is slow, and the available water capacity is low to moderate. Salinity is moderate to high, and the soils are strongly alkaline to very strongly alkaline. The precipitation is 10 to 14 inches.

The climax vegetation is about 55 percent alkali sacaton, Nuttall alkaligrass, western wheatgrass, alkali bluegrass, fourwing saltbush, Gardner saltbush, and winterfat and about 45 percent inland saltgrass, bottlebrush squirreltail, twogrooved milkvetch, pointvetch, woody aster, greasewood, rubber rabbitbrush, and cottonwood. If range condition declines, greasewood, inland saltgrass, and invading plants generally become dominant. The principal invaders are annuals and foxtail barley.

Among the practices that apply to this site are proper grazing use, deferred grazing, and a planned system of grazing. Other practices that can be used in most areas are brush control and the development of stock water.

If this site is in excellent condition, the estimated annual yield per acre of air-dry herbage is about 2,200 pounds in favorable years and 1,400 pounds in unfavorable years. About 75 to 80 percent of this production is plants that furnish forage for cattle, sheep, horses, and wildlife.

SALINE SUBIRRIGATED RANGE SITE, 10 TO 14 INCH PRECIPITATION ZONE

This range site consists of somewhat poorly drained or poorly drained soils of the Connerton, Glenberg, Haverson, and Kim series and Saline, wet land. These soils are saline and have a fluctuating water table that is within the root zone during part of the growing season. Slopes are 0 to 6 percent. Permeability is moderate to moderately rapid, and the available water capacity is moderate. The seasonal high water table is at a depth of 10 to 40 inches. The precipitation is 10 to 14 inches.

The climax vegetation is about 60 percent alkali cordgrass, alkali sacaton, Nuttall alkaligrass, and western wheatgrass and about 40 percent alkali bluegrass, inland saltgrass, bottlebrush squirreltail, seepweed, greasewood, and rubber rabbitbrush. If range condition declines, inland saltgrass generally becomes dominant.

Among the practices that apply to this site are proper grazing use, deferred grazing, and a planned system of grazing. Other practices that can be used in most areas are brush control and the development of stock water.

If this site is in excellent condition, the estimated annual yield per acre of air-dry herbage is about 3,500 pounds in favorable years and 2,500 pounds in unfavorable years. About 75 percent of this production is plants that furnish forage for cattle, sheep, horses, and wildlife.

SANDS RANGE SITE, 10 TO 14 INCH PRECIPITATION ZONE

This range site consists of somewhat excessively drained or excessively drained soils of the Bankard and Valent series and Alluvial land. These soils have a surface layer of loamy sand and underlying material of fine sand. Slopes are 0 to 20 percent. Permeability is rapid, and the available water capacity is low. The precipitation is 10 to 14 inches.

The climax vegetation is about 60 percent prairie sandreed, Indian ricegrass, sand bluestem, and priarieclover and about 40 percent western wheatgrass, needle-and-thread, blue grama, sand dropseed, threadleaf sedge, cudweed sagewort, green sagewort, fringed sagewort, yucca, and silver sagebrush. If range condition declines, forbs and invading plants generally become dominant. The principal invaders are annuals and broom snakeweed.

Among the practices that apply to this site are proper grazing use, deferred grazing, and a planned system of grazing. Another practice that can be used in some areas is development of stock water.

If this site is in excellent condition, the estimated annual yield per acre of air-dry herbage ranges from about 2,500 pounds in favorable years to 1,400 pounds in unfavorable years. About 85 to 90 percent of this production is plants that furnish forage for cattle, sheep, horses, and wildlife.

SANDY RANGE SITE, 10 TO 14 INCH PRECIPITATION ZONE

This range site consists of well-drained soils of the Embry, Julesburg, Otero, and Terry series. These soils have a surface layer and subsoil or underlying layers of sandy loam or fine sandy loam. Slopes are 0 to 20 percent. Permeability is moderately rapid, and the available water capacity is low to high. The precipitation is 10 to 14 inches.

The climax vegetation is about 50 percent prairie sandreed Indian ricegrass, little bluestem, prairieclover, American vetch, and winterfat and about 50 percent western wheatgrass, needle-and-thread, blue grama, sand dropseed, threadleaf sedge, needleleaf sedge, cudweed sagewort, silverleaf scurfpea, western yarrow, tailcup lupine, fringed sagewort, yucca, and silver sagebrush. If range condition declines, fringed sagewort, cudweed, and other invading plants generally become dominant. The principal invaders are annuals and cactus.

Among the practices that apply to this site are proper grazing use, deferred grazing, and a planned system of grazing. Other practices that can be used in most areas are range seeding, brush control, and the development of stock water.

If this site is in excellent condition, the estimated annual yield per acre of air-dry herbage ranges from about 2,100 pounds in favorable years to 1,000 pounds in unfavorable years. About 85 to 90 percent of this production is plants that furnish forage for cattle, sheep, horses, and wildlife.

SHALLOW CLAYEY RANGE SITE, 10 TO 14 INCH PRECIPITATION ZONE

This range site consists of well-drained to somewhat excessively drained soils of the Cragola, Danko, Moret, Samsil, Shingle, Shirk, and Sunup series. These soils are 10 to 20 inches deep, but bedrock is at a depth of 20 to 40 inches in the Shirk soil. These soils have a surface layer of very gravelly loam to clay and underlying layers of channery clay loam to clay. Slopes are 10 to 40 percent. Permeability is slow to moderate, and the available water capacity is low to moderate. The precipitation is 10 to 14 inches.

The climax vegetation is about 70 percent green needlegrass, western wheatgrass, thickspike wheatgrass, bluebunch wheatgrass, American vetch, prairieclover, and winterfat and about 30 percent blue grama, Sandberg bluegrass, plains reedgrass, prairie junegrass, threadleaf sedge, aster, biscuitroot, mountain thermopsis, hawksbeard, and big sagebrush. If range condition declines, big sagebrush and invading plants generally become dominant. The principal invaders are annuals, broom snakeweed, and curlycup gumweed.

Among the practices that apply to this site are proper grazing use, deferred grazing, and a planned system of grazing. Another practice that can be used in most areas is the development of stock water.

If this site is in excellent condition, the estimated annual yield per acre of air-dry herbage ranges from about 1,200 pounds in favorable years to 450 pounds in unfavorable years. About 80 to 90 percent of this production is plants that furnish forage for cattle, sheep, horses, and wildlife.

SHALLOW LOAMY RANGE SITE, 10 TO 14 INCH PRECIPITATION ZONE

This range site consists of well-drained to excessively drained soils of the Rekop, Shingle, Spearfish, and Worf series. These soils are 10 to 20 inches deep. They have a surface layer of loam or very fine sandy loam and a subsoil or underlying layers of gravelly loam to light clay loam. Slopes are 3 to 40 percent. Permeability is moderate, and the available water capacity is low. The precipitation is 10 to 14 inches.

The climax vegetation is about 65 percent bluebunch wheatgrass, western wheatgrass, needle-and-thread, little bluestem, Cusick bluegrass, American vetch, prairieclover, and winterfat and about 35 percent blue grama, Sandberg bluegrass, stonyhills muhly, prairie junegrass, threadleaf sedge, biscuitroot, Hoods phlox, locoweed, and mountain thermopsis. If range condition declines, blue grama, threadleaf sedge, and invading plants generally become dominant. The principal invaders are annuals and broom snakeweed.

Among the practices that apply to this site are proper grazing use, deferred grazing, and a planned system of grazing. Among other practices that can be used in most areas is the development of stock water.

If this site is in excellent condition, the estimated annual yield per acre of air-dry herbage ranges from 1,200 pounds in favorable years to 450 pounds in unfavorable years. About 85 to 90 percent of this production is plants that furnish forage for cattle, sheep, horses, and wildlife.

SHALLOW SANDY RANGE SITE, 10 TO 14 INCH PRECIPITATION ZONE

This range site consists of somewhat excessively drained to excessively drained soils of the Schooner, Southfork, Tassel, and Travessilla series. These soils are 10 to 20 inches deep. Generally, they have a surface layer and underlying layers of sandy loam, except for the Schooner and Southfork soils that have a surface layer of loamy sand, a subsoil of sandy loam, and underlying material of fine sand. Slopes are 10 to 40 percent. Permeability is moderately rapid or rapid, and the available water capacity is low. The precipitation is 10 to 14 inches.

The climax vegetation is about 65 percent prairie sandreed, bluebunch wheatgrass, little bluestem, needle-and thread, prairieclover, American vetch, and winterfat and about 35 percent blue grama, sand dropseed, stonyhills muhly, threadleaf sedge, Hoods phlox, green sagewort, yucca, fringed sagewort, and silver sagebrush. If range condition declines, threadleaf sedge, fringed sagewort, and invaders generally become more dominant. The principal invaders are annuals.

Among the practices that apply to this site are proper grazing use, deferred grazing, and a planned system of grazing. In addition, the development of stock water is needed for proper management of this site.

If this site is in excellent condition, the estimated annual yield per acre of air-dry herbage ranges from about 1,400 pounds in favorable years to 600 pounds in unfavorable years. About 85 to 90 percent of this production is plants that furnish forage for cattle, sheep, horses, and wildlife.

VERY SHALLOW RANGE SITE, 10 TO 14 INCH PRECIPITATION ZONE

This range site consists of well-drained to excessively drained soils of the Samsil, Shingle, Spearfish, and Tassel series. These soils are 8 to 10 inches deep to bedrock. Slopes are 30 to 40 percent. Permeability is slow to moderately rapid, and the available water capacity is low. The precipitation is 10 to 14 inches.

The climax vegetation is about 55 percent bluebunch wheatgrass, little bluestem, needle-and-thread, threadleaf sedge, curlyleaf mountain-mahogany and about 45 percent blue grama, Sandberg bluegrass, stonyhills muhly, red three-awn, prairie junegrass, Hoods phlox, fringed

sagewort, big sagebrush, ponderosa pine, and skunkbush sumac. If range condition declines, woody plants and invading plants generally become dominant. The principal invaders are annuals.

Among the practices that apply to this site are proper grazing use, deferred grazing, and a planned system of grazing. In addition, the development of stock water is needed for proper range management.

If this site is in excellent condition, the estimated annual yield per acre of air-dry herbage ranges from about 800 pounds in favorable years to 250 pounds in unfavorable years. About 70 percent of this production is plants that furnish forage for cattle, sheep, horses, and wildlife.

CLAYEY RANGE SITE, 15 TO 19 INCH PRECIPITATION ZONE

This range site consists of well-drained soils of the Turk series. These soils have a surface layer of silty clay and a subsoil of clay. Slopes are 6 to 20 percent. Permeability is slow, and the available water capacity is low to moderate. The precipitation is 18 to 19 inches.

The climax vegetation is about 65 percent Columbia needlegrass, spike fescue, Idaho fescue, bluebunch wheatgrass, mountain brome, and forbs and about 35 percent western wheatgrass, thickspike wheatgrass, Letterman needlegrass, prairie junegrass, mutton bluegrass, phlox, starry cerastium, western yarrow, larkspur, lupine, and big sagebrush. If range condition declines, big sagebrush and invading plants generally become dominant. The principal invaders are annuals, dandelion, and meadow salsify.

Among the practices that apply to this site are proper grazing use, deferred grazing, and a planned system of grazing. Other practices that can be used in most areas are brush control and the development of stock water.

If this site is in excellent condition, the estimated annual yield per acre of air-dry herbage ranges from about 2,500 pounds in favorable years to 1,100 pounds in unfavorable years. About 85 to 90 percent of this production is plants that furnish forage for cattle, sheep, horses, and wildlife.

COARSE UPLAND RANGE SITE, 15 TO 19 INCH PRECIPITATION ZONE

This range site consists of well-drained soils of the Nathrop series. These soils have a surface layer of stony loam and a subsoil of gravelly to stony clay loam. Slopes are 10 to more than 30 percent. Permeability is moderate, and the available water capacity is low to moderate. The precipitation is 15 to 19 inches.

The climax vegetation is about 60 percent big bluegrass, mountain brome, Pumpelly brome, Columbia needlegrass, Idaho fescue, bluebunch wheatgrass, forbs, and woody plants and about 40 percent western wheatgrass, Sandberg bluegrass, prairie junegrass, one-spike oatgrass, aster, larkspur, lupine, and big sagebrush. If range condition declines, big sagebrush and forbs generally become dominant. The principal invaders are annuals and common dandelion.

Among the practices that apply to this site are proper grazing use, deferred grazing, and a planned system of grazing. Other practices that can be used in most areas are brush control and the development of stock water.

If this site is in excellent condition, the estimated annual yield per acre of air-dry herbage ranges from about 1,100 pounds in favorable years to 600 pounds in unfavorable years. About 75 to 80 percent of this production is plants that furnish forage for cattle, sheep, horses, and wildlife.

LOAMY RANGE SITE, 15 TO 19 INCH PRECIPITATION ZONE

This range site consists of well drained and moderately well drained soils of the Amsden, Auzqui, Bachus, Decross, Leavitt, Lymanson, Passcreek, Stubbs, Tripit, and Woosley series. Generally, these soils have a loamy surface layer, subsoil, or underlying material, but some of them have a gravelly subsoil. Slopes are 6 to 30 percent. Permeability is moderate to moderately rapid, and the available water capacity is low to high. The precipitation is 15 to 19 inches.

The climax vegetation is about 70 percent Columbia needlegrass, spike fescue, Idaho fescue, bluebunch wheatgrass, mountain brome, and forbs and about 30 percent western wheatgrass, thickspike wheatgrass, prairie junegrass, mutton bluegrass, Letterman needlegrass, and upland sedges. If range condition declines, big sagebrush, forbs, and invading plants generally become dominant. The principal invaders are annuals, common dandelion, goatsbeard, and foxtail barley.

Among the practices that apply to this site are proper grazing use, deferred grazing, and a planned system of grazing. Other practices that can be used in most areas are brush control and the development of stock water.

If this site is in excellent condition, the estimated annual yield per acre of air-dry herbage ranges from 2,500 pounds in favorable years to 1,100 pounds in unfavorable years. About 85 to 90 percent of this production is plants that furnish forage for cattle, sheep, horses, and wildlife.

SANDY RANGE SITE, 15 TO 19 INCH PRECIPITATION ZONE

This range site consists of well-drained soils of the Burgess, Poker, Sawcreek, and Sublette series. These soils have a surface layer and subsoil of sandy loam. Slopes are 6 to 20 percent. Permeability is moderately rapid, and the available water capacity is low to moderate. The precipitation is 17 to 19 inches.

The climax vegetation is about 70 percent mountain brome, Pumpelly brome, Columbia needlegrass, and forbs and about 50 percent western wheatgrass, thickspike wheatgrass, Letterman needlegrass, prairie junegrass, phlox, starry cerastium, western yarrow, larkspur, lupine, and big sagebrush. If range condition declines, big sagebrush, forbs, and invading plants generally become dominant. The principal invaders are common dandelion and meadow salsify.

Among the practices that apply to this site are proper grazing use, deferred grazing, and a planned system of grazing. Other practices that can be used in most areas are brush control and the development of stock water.

If this site is in excellent condition, the estimated annual yield per acre of air-dry herbage ranges from 2,500 pounds in favorable years to 1,100 pounds in unfavorable years. About 85 to 90 percent of this production is plants that furnish forage for cattle, sheep, horses, and wildlife.

SHALLOW CLAYEY RANGE SITE, 15 TO 19 INCH PRECIPITATION ZONE

This range site consists of well-drained soils of the Devoe and Jenkinson series. These soils are 10 to 20 inches deep. They have a surface layer of gravelly loam to clay loam and a subsoil and underlying material of gravelly clay loam to clay loam. Slopes are 10 to 40 percent. Permeability is moderate, and the available water capacity is low. The precipitation is 15 to 19 inches.

The climax vegetation is about 65 percent Columbia needlegrass, Idaho fescue, spike fescue, bluebunch wheatgrass, and forbs and about 35 percent western wheatgrass, thickspike wheatgrass, prairie junegrass, Sandberg bluegrass, phlox, aster, starry cerastium, lupine, and big sagebrush. If range condition declines, big sagebrush and invading plants generally become dominant. The principal invaders are annual plants.

Among the practices that apply to this site are proper grazing use, deferred grazing, development of stock water, and a planned system of grazing.

If this site is in excellent condition, the estimated annual yield per acre of air-dry herbage ranges from about 1,600 pounds in favorable years to 500 pounds in unfavorable years. About 85 to 90 percent of this production is plants that furnish forage for cattle, sheep, horses, and wildlife.

SHALLOW LOAMY RANGE SITE, 15 TO 19 INCH PRECIPITATION ZONE

This range site consists of well-drained to excessively drained soils of the Hazton, Splitro, Starley, and Tolman series. These soils are 10 to 20 inches deep. Generally, they have a surface layer of loam or stony loam and underlying layers of gravelly to cobbly clay loam, except that the Hazton and Splitro soils are sandy loam or gravelly coarse sandy loam throughout. Slopes are 10 to 40 percent. Permeability is moderate or moderately rapid, and the available water capacity is low. The precipitation is 15 to 19 inches.

The climax vegetation is about 65 percent Columbia needlegrass, Idaho fescue, spike fescue, bluebunch wheatgrass, and forbs and about 35 percent upland sedges, western wheatgrass, thickspike wheatgrass, prairie junegrass, one-spike oatgrass, phlox, starry cerastium, larkspur, lupine, and big sagebrush. If range condition declines, big sagebrush and invading plants generally become dominant. The principal invaders are annuals, broom snakeweed, and curlycup gumweed.

Among the practices that apply to this site are proper grazing use, deferred grazing, and a planned system of grazing. Among other practices that can be used in most areas is the development of stock water.

If this site is in excellent condition, the average annual yield per acre of air-dry herbage ranges from about 1,600 pounds in favorable years to 500 pounds in unfavorable years. About 85 to 90 percent of this production is plants that furnish forage for cattle, sheep, horses, and wildlife.

SUBIRRIGATED RANGE SITE, 15 TO 19 INCH PRECIPITATION ZONE

This range site consists only of the Slocum part of the Auzqui-Slocum association. This soil is somewhat poorly drained. It has a fluctuating water table that is within the root zone during part of the growing season. Slopes are 3 to 10 percent. Permeability is moderate, and the available water capacity is high. The seasonal high water table is below a depth of 40 inches, but the soil is moist above a depth of 40 inches during part of the growing season. The precipitation is 18 to 19 inches.

The climax vegetation is about 55 percent Nebraska sedge, northern reedgrass, alpine timothy, slender wheatgrass, and forbs and about 45 percent tufted hairgrass, mat muhly, Idaho fescue, low sedge, dock, American bistort, fleabane, willow, and shrubby cinquefoil. If range condition declines, annuals generally become dominant.

Among the practices that apply to this site are proper grazing use, deferred grazing, brush control, and a planned system of grazing.

If this site is in excellent condition, the estimated annual yield per acre of air-dry herbage ranges from about 5,500 pounds in favorable years to 3,000 pounds in unfavorable years. About 75 to 80 percent of the production is plants that furnish forage for cattle, sheep, horses, and wildlife.

VERY SHALLOW RANGE SITE, 15 TO 19 INCH PRECIPITATION ZONE

This range site consists of well-drained to excessively drained soils of the Hazton and Starley series. These soils are 8 to 10 inches deep to bedrock. Slopes are 30 to 40 percent. Permeability is moderate to moderately rapid, and the available water capacity is low. The precipitation is 15 to 19 inches.

The climax vegetation is about 65 percent mountain muhly, Columbia needlegrass, Idaho fescue, bluebunch wheatgrass, forbs, and curlleaf mountain-mahogany and about 35 percent western wheatgrass, prairie junegrass, one-spike oatgrass, phlox, starry cerastium, pussytoes, stonecrop, sandwort, conifers, and big sagebrush. If range condition declines, forbs and invading plants generally become dominant. The principal invaders are annuals.

Among the practices that apply to this site are proper grazing use, deferred grazing, the development of stock water, and a planned system of grazing.

If this site is in excellent condition, the estimated annual yield per acre of air-dry herbage ranges from 900 pounds in favorable years to 400 pounds in unfavorable years. About 70 percent of this production is plants that furnish forage for cattle, sheep, horses, and wildlife.

Management for Woodland

About 35,000 acres in Johnson County, Southern Part, is woodland. Most of the wooded areas are small, scattered stands that have value mainly for watershed, wildlife habitat, and recreation. On the Big Horn Mountains are stands of lodgepole pine, Douglas-fir, and Engelmann spruce. On the eastern flank of the mountains where slopes face north and east are stands of ponderosa pine. On Pine Ridge, in the southeastern part of the survey area, stands of ponderosa pine also grow.

These forested areas provided considerable production early in the development of the survey area. One such area west of Mayoworth, known as the Pole Patch, provided logs for many houses of the early homesteaders. Indications are that sizable areas burned about 80 to

100 years ago. The burned areas now have stands of lodgepole pine, and unburned areas have stands of Douglas-fir and Engelmann spruce. Remnant areas of overmature Douglas-fir remain in some of the younger stands of lodgepole pine.

These stands of trees are under private, State, and Federal ownership, and they provide posts, poles, and lumber mainly for local use. Only a few sawmill operators work in the timber stands.

Fertility, texture, and available water capacity are soil factors that affect tree growth. Along with elevation, aspect, and climate, these factors affect the growth of trees and the kinds of trees that grow on a particular site. The depth of the root zone and the available water capacity also are important.

The few wooded soils of the survey area have been placed in groups on the basis of their suitability for trees. Each group is made up of soils that produce similar kinds of woodland crops, require similar management, and have about the same productivity. For each group, a relative rating of high, medium, or low is given for timber production.

The potential species and productivity for wood crops are shown, as follows:

Woodland group and map symbols	Potential species	Productivity for wood crops
Group 1: CD, PG	Engelmann spruce and Douglas-fir.	Medium.
Group 2: SF	Douglas-fir and lodgepole pine.	Low to medium.
Group 3: Bayerton part of BM, Slipman part of PA.	Ponderosa pine	Medium.
Group 4: Simmont part of SOE	Ponderosa pine	Low.
Group 5: Gateson part of GA and PU.	Ponderosa pine	Medium.

Management for Wildlife

Johnson County, Southern Part, is favorable for many kinds of wildlife. The areas of range and intermingled irrigated and dryland areas, woodland areas, and streams provide food and cover for many wild animals, birds, and fish.

Antelope are the most abundant big-game animals, but there also are many deer and elk. Beaver and muskrat live along the main streams. Waterfowl live along the main streams and on many stock-water ponds. Rainbow trout, brown trout, brook trout, and cutthroat trout live in mountain streams and on the North Fork, Middle Fork, and Red Fork of Powder River, below the mountains. There are cottontail rabbits, jackrabbits, coyotes, pheasants, and a few wild turkeys in the survey area. Range areas provide food and cover for many sage grouse.

The wildlife population is largely determined by the ability of the habitat to produce appropriate food, cover, and water. Wildlife habitats differ in their capacity to provide these essential elements. Some of the differences are related to soils, and others are related to management. Good management practices are needed for the use of soils as wildlife habitat.

The soils of Johnson County, Southern Part, have been grouped into three wildlife habitat types. In the following paragraphs, these habitat types are described, wildlife species are listed, and their needs are mentioned. Each habitat type, or area, consists of the soil associations shown on the General Soil Map, which is at the back of this survey, and described in the section "General Soil Map."

WILDLIFE HABITAT TYPE 1

This habitat makes up about 14 percent of the survey area. It is on the tops of mountains and is designated as soil association 10 on the General Soil Map. This area is used mainly for range, woodland, and wildlife habitat.

The soils are mainly of the Starley, Nathrop, and Woosley series. Among the other soils of this habitat are those of the Bachus, Burgess, Cloud Peak, Decross, Dell, Mathers, Tripit, and Wetterhorn series.

The vegetation consists of grasses, sedges, and forbs in the open park areas and conifers in the timbered areas. The habitat furnishes food, cover, and water for deer, elk, and in some places a few moose and antelope. Most streams in this area contain several species of trout.

Conservation problems arise because big-game animals compete with livestock for food.

WILDLIFE HABITAT TYPE 2

This habitat makes up about 79 percent of the survey area. The areas of this habitat, on uplands below the tops of mountains and above stream channels, are designated as soil associations 3, 4, 6, 7, 8, and 9 on the General Soil Map. The major soils of these associations are those of the Briggsdale, Renohill, Cushman, Gaynor, Samsil, Shingle, Schooner, Cragola, Wolf, Big Horn, Sunup, and Spearfish series and Rock land. Many other soils, besides the major soils that name these associations, are in this habitat. There are a few dry-farmed areas near Ninemile Creek and Fourmile Creek.

The vegetation consists of short grasses, mid grasses, dryland sedges, forbs, and woody plants. The habitat is populated by antelope, deer, cottontail rabbits, jackrabbits, sage grouse, and some pheasants, along with various numbers of coyotes and fox. Many stock-water ponds provide resting areas for ducks.

Conservation problems arise mainly because wildlife compete with livestock. Generally, management for livestock complements management for wildlife; however, such practices as fenced dry pasture, heavy grazing, and sagebrush spraying can be detrimental to wildlife.

WILDLIFE HABITAT TYPE 3

This habitat makes up about 7 percent of the survey area. It is along Powder River and its tributaries below the mountains and is designated as soil associations 1 and 2 on the General Soil Map. The major soils in these associations are of the Stoneham, Haverson, Glenberg, Connerton, Barnum, and Redbank series. In addition to the major soils that name these associations, soils of the Bankard, Kim, Lohmiller, Limon, Wyarno, and Zigweid series are in this habitat. The area consists of alluvial bottoms along streams and the adjacent valleysides. It

is used mainly for irrigated hay, small grain, pasture, and to a minor extent for range and wildlife habitat.

The vegetation consists of alfalfa, bromegrass, and small grain on irrigated fields and short grasses, tall grasses, wetland sedges, and cottonwood and willow trees along streams. This habitat is used by antelope and deer as well as livestock, and has a higher carrying capacity than the other habitats in the survey area. Waterfowl, beaver, and muskrat use the creek bottoms for food and nesting. Trout are in the Middle Fork, Red Fork, and North Fork of the Powder River.

Among the conservation problems are control of sediment in the drainage areas of streams, control of erosion on streambanks, and control of winter damage to haystacks caused by deer.

Engineering Uses of the Soils

This section is useful to those who need information about soils used as structural material or as foundations upon which structures are built. Among those who can benefit from this section are planning commissions, town and city managers, land developers, engineers, contractors, and farmers.

Among properties of soils highly important in engineering are permeability, strength, compaction characteristics, drainage, shrink-swell potential, grain size, plasticity, and reaction. Also important are depth to the water table, depth to bedrock, and slope. These properties, in various degrees and combinations, affect construction and maintenance of roads, airports, pipelines, foundations for small buildings, irrigation systems, ponds and small dams, and systems for disposal of sewage and refuse.

Information in this section of the soil survey can be helpful to those who—

1. Select potential residential, industrial, commercial, and recreational areas.
2. Evaluate alternate routes for roads, highways, pipelines, and underground cables.
3. Seek sources of gravel, sand, or clay.
4. Plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for controlling water and conserving soil.
5. Correlate performance of structures already built with properties of the kinds of soil on which they are built, for the purpose of predicting performance of structures on the same or similar kinds of soil in other locations.
6. Predict the trafficability of soils for cross-country movement of vehicles and construction equipment.
7. Develop preliminary estimates pertinent to construction in a particular area.

Most of the information in this section is presented in tables 4, 5, and 6. Table 4 shows several estimated soil properties significant to engineering; table 5 gives interpretations for various engineering uses; and table 6 shows the results of engineering laboratory tests on soil samples.

This information, along with the soil map and data in other parts of this publication, can be used to make interpretations in addition to those given in tables 4 and 5, and it also can be used to make other useful maps.

This information, however, does not eliminate the need for further investigation at sites selected for engineering works, especially works that involve heavy loads or require excavations to depths greater than those shown in the tables, generally depths of more than 6 feet. Inspection of sites, especially small ones, also is needed because many delineated areas of a given soil mapping unit contain small areas of other kinds of soil that have strongly contrasting properties and different suitabilities or limitations for soil engineering.

Some of the terms used in this soil survey have special meaning to soil scientists. The Glossary defines many of these terms as they are commonly used in soil science.

Engineering soil classification systems

The two systems most commonly used in classifying samples of soils for engineering are the Unified system (*9*, *3*) used by the Soil Conservation Service engineers, Department of Defense, and other agencies, and the AASHO system (*1*, *3*) adopted by the American Association of State Highway Officials.

In the Unified system soils are classified according to particle-size distribution, plasticity, liquid limit, and organic-matter content. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt.

The AASHO system is used to classify soils according to those properties that affect use in highway construction and maintenance. In this system a soil is placed in one of seven basic groups, which range from A–1 through A–7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A–1 are gravelly soils of high bearing strength, or the best soils for subgrade (foundation). At the other extreme, in group A–7 are clay soils that have low strength when wet and that are the poorest soils for subgrade. Where laboratory data are available to justify a further breakdown, the A–1, A–2, and A–7 groups are divided as follows: A–1–a, A–1–b; A–2–4, A–2–5, A–2–6, A–2–7; A–7–5, and A–7–6. As additional refinement, the engineering value of a soil material can be indicated by a group index number. Group indexes range from 0 for the best material to 20 or more for the poorest. The AASHO classification for tested soils, with group index numbers in parentheses, is shown in table 6; the estimated classification, without group index numbers, is given in table 4 for all soils mapped in the survey area.

Soil properties significant to engineering

Several estimated soil properties significant in engineering are shown in table 4. These estimates are made for representative soil profiles, by layers sufficiently different to have different significance in soil engineering. The estimates are based on field observations made in the course of mapping, on test data for these and similar soils, and on experience with the same kinds of soil in other counties. Following are explanation of some of the columns in table 4.

529-425—75——8

TABLE 4.—*Estimated soil properties*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soils. The soils tions for referring to other series that appear in the first column of

Soil series and map symbols	Depth to bedrock	Depth from surface	Classification: Dominant USDA texture	Classification: Unified	Classification: AASHO	Coarse fraction greater than 3 inches
	In.	*In.*				*Pct.*
*Absted: Aa, AB, ADB, ADC	40–60	0–3	Very fine sandy loam	CL	A–6	0–5
For Bone soil in AB and Wyarno soils in ADB and ADC, see their respective series.		3–60	Clay	CH	A–7	0
Alluvial land: AL. Properties too variable to be estimated.						
*Amsden: AM	40–60	0–8	Loam	ML or MH	A–7	0–5
For Decross soil in this unit, see Decross series.		8–23	Clay loam	ML or CL	A–7	0–5
		23–60	Clay loam	ML or CL	A–7	0–5
*Ascalon: AS	>60	0–10	Fine sandy loam	CL	A–6	0–5
For Julesburg soil in this unit, see Julesburg series.		10–28	Sandy clay loam	SC or CL	A–6 or A–7	0–5
		28–60	Sandy clay loam	SC or CL	A–6	0–5
*Auzqui: AU	40–60	0–12	Loam	CL	A–7	0–5
For Slocum soil, see Slocum series.		12–60	Clay loam	ML to CL	A–7	0–5
Bachus	20–40	0–17	Loam	ML	A–4	0–5
Mapped only in an association with Fokel and Splitro soils.		17–31	Clay loam	CL	A–6	15
		31	Hard sandstone.			
Badland: BA. Properties too variable to be estimated.						
Bankard: Bd	>60	0–60	Loamy sand and loamy fine sand.	SW	A–2	0–5
*Barnum: Be, BK	>60	0–4	Very fine sandy loam	CL	A–6	0–5
For Redbank soil in BK, see Redbank series.		4–60	Loam	CL	A–6	0–5
Barnum, sandy subsoil variant: Bf	>60	0–24	Loam	CL	A–6	0–5
		24–60	Fine sand	SC	A–2	0–5
*Bayerton: BM	20–40	0–7	Loam	CL	A–6	0–10
For Tolman soil in this unit, see Tolman series.		7–24	Sandy clay loam	SC	A–6	0–10
		24	Hard sandstone.			
Bidman	40–60	0–5	Loam	CL	A–6	0–10
Mapped only in complex with Briggsdale soil.		5–18	Clay	CH	A–7	0–5
		18–60	Clay loam	CL	A–6	0–5
*Big Horn: BN	>60	0–4	Loam	CL	A–6	5–10
For Wolf soil in this unit, see Wolf series.		4–26	Clay	CH	A–7	5–10
		26–60	Gravelly clay loam	CL	A–6	5–10
Bone	>60	0–60	Silty clay or silty clay loam	CH	A–7	0–5
Mapped only in complexes with Absted and Petrie soils.						
*Briggsdale: BoB, BoC, BRD, BSD, BT, BU, BWD, BWE.	20–40	0–6	Very fine sandy loam	CL	A–6	0–5
For Bidman soil in BRD, Lohsman soil in BSD, Pugsley soil in BT, Renohill soil in BU, and Worf soils in BWD and BWE, see their respective series.		6–16	Clay loam	CL	A–7	0–5
		16–28	Silty clay and silty clay loam	CL	A–6	0–5
		28	Soft shale.			

significant to engineering

in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instruc-
this table. The sign > means more than; the sign < mean less than]

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permea-bility	Available water capacity	Reaction	Salinity	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)							
						In. per hr.	*In. per in. of soil*	*pH*	*Mmhos. per cm. at 25° C.*	
95–100	95–100	85–95	50–65	25–35	10–15	2. 0–6. 0	0. 15–0. 17	6. 6–7. 8	<2. 0	Low.
85–100	85–100	70–100	65–95	50–60	30–40	0. 06–0. 2	0. 09–0. 11	7. 9–9. 0+	2. 0–8. 0	High.
95–100	95–100	90–95	75–80	45–55	15–25	0. 6–2. 0	0. 16–0. 18	6. 6–7. 8	<2. 0	Low.
95–100	95–100	90–95	80–85	40–50	15–25	0. 6–2. 0	0. 19–0. 21	6. 6–7. 8	<2. 0	Moderate.
95–100	90–95	90–95	70–80	40–50	15–25	0. 6–2. 0	0. 19–0. 21	7. 9–9. 0	<2. 0	Moderate.
95–100	95–100	85–95	65–75	25–35	15–20	0. 6–2. 0	0. 16–0. 18	6. 6–7. 8	<2. 0	Moderate.
95–100	95–100	80–90	35–55	35–45	20–30	0. 6–2. 0	0. 14–0. 16	7. 4–8. 4	<2. 0	Moderate.
95–100	95–100	80–90	35–55	30–40	20–30	0. 6–2. 0	0. 14–0. 16	8. 5–9. 0	<2. 0	Moderate.
95–100	95–100	90–95	80–90	40–50	10–15	0. 6–2. 0	0. 19–0. 21	7. 4–9. 0	<2. 0	Low.
95–100	95–100	90–95	80–90	40–50	15–25	0. 6–2. 0	0. 19–0. 21	7. 9–9. 0	<2. 0	Moderate.
75–100	75–100	65–90	50–65	20–30	0–5	0. 6–2. 0	0. 16–0. 18	5. 6–6. 5	<2. 0	Low.
75–100	75–100	70–90	55–75	30–40	15–20	0. 6–2. 0	0. 19–0. 21	5. 6–6. 5	<2. 0	Moderate.
90–100	90–100	60–80	20–35	5–10	[1] NP	6. 0–20. 0	0. 05–0. 07	7. 4–9. 0	2. 0–8. 0	Low.
85–100	85–100	70–95	50–65	20–30	10–20	0. 6–2. 0	0. 15–0. 17	7. 9–9. 0	2. 0–8. 0	Low.
85–100	85–100	70–95	50–75	25–35	15–20	0. 6–2. 0	0. 16–0. 18	7. 9–9. 0	2. 0–8. 0	Moderate.
85–100	85–100	70–95	50–75	20–30	10–20	0. 6–2. 0	0. 19–0. 21	7. 4–9. 0	2. 0–4. 0	Moderate.
85–100	85–100	50–65	25–35	15–25	5–10	2. 0–6. 0	0. 11–0. 13	7. 9–9. 0	2. 0–4. 0	Low.
75–100	75–100	65–90	50–65	30–35	15–20	0. 6–2. 0	0. 16–0. 18	5. 6–7. 8	<2. 0	Moderate.
75–100	75–100	60–90	35–50	30–40	15–20	0. 6–2. 0	0. 16–0. 18	5. 6–8. 4	<2. 0	Low.
90–100	90–100	70–95	50–75	30–40	15–20	0. 6–2. 0	0. 16–0. 18	6. 1–6. 5	<2. 0	Moderate.
90–100	90–100	80–100	70–95	50–60	30–40	0. 2–0. 6	0. 14–0. 16	7. 4–7. 8	<2. 0	High.
90–100	90–100	80–100	65–80	35–40	20–30	0. 6–2. 0	0. 19–0. 21	8. 0–8. 6	<2. 0	Moderate.
95–100	95–100	85–95	60–75	30–40	15–25	0. 6–2. 0	0. 16–0. 18	6. 6–7. 8	<2. 0	Moderate.
95–100	95–100	90–100	75–95	50–60	30–40	0. 2–0. 6	0. 14–0. 16	6. 6–8. 4	<2. 0	High.
60–70	60–70	55–70	50–55	30–40	15–20	0. 6–2. 0	0. 19–0. 21	7. 9–9. 0	<2. 0	Moderate.
90–100	90–100	80–100	80–95	50–60	30–40	<0. 6	0. 07–0. 09	7. 9–9. 0+	2. 0–8. 0	High.
90–100	90–100	75–95	50–65	20–30	10–20	0. 6–2. 0	0. 15–0. 17	6. 6–7. 8	<2. 0	Moderate.
90–100	90–100	80–100	65–80	40–50	25–40	0. 2–0. 6	0. 19–0. 21	6. 6–7. 8	<2. 0	Moderate.
90–100	90–100	80–100	65–80	35–40	20–30	0. 6–2. 0	0. 19–0. 21	7. 9–9. 0	<2. 0	Moderate.

TABLE 4.—*Estimated soil properties*

Soil series and map symbols	Depth to bedrock	Depth from surface	Classification: Dominant USDA texture	Classification: Unified	Classification: AASHO	Coarse fraction greater than 3 inches
	In.	*In.*				*Pct.*
Burgess. Mapped only in association with Hazton soils.	20–40	0–9	Gravelly coarse sandy loam	SM	A–1 or A–2	5–10
		9–30	Gravelly coarse sandy loam	SC	A–2	5–10
		30	Granite.			
Cadoma. Mapped only in association with Limon soils and in complex with Samsil and Gaynor soils.	20–40	0–24	Silty clay	CL or CH	A–7	0–5
		24	Soft alkaline shale.			
Carnero. Mapped only in association with Sunup soils.	20–40	0–7	Loam	CL	A–6	5–10
		7–20	Clay loam	CL	A–6	5–10
		20–26	Gravelly clay loam	CL	A–6	10–15
		26	Hard sandstone.			
*Cloud Peak: CD. For Dell soil in this unit, see Dell series.	20–40	0–4	Very fine sandy loam	CL	A–6	10
		4–18	Stony silty clay loam	GC	A–2	22
		18–32	Stony loam	GC	A–2	25
		32	Hard limestone.			
Colluvial land: CE. Properties too variable to be estimated.						
*Connerton: CnA, CnB, CnC, CnD, Co, CR, CS. For La Fonda soil in CR and Spearfish soil in CS, see their respective series.	>60	0–60	Loam	CL	A–6	0–5
*Cragola: CT, CU. For Ascalon soil in CT and Shingle soil in CU, see their respective series.	10–20	0–16	Very gravelly clay loam	GC	A–2	15–30
		16	Soft siltstone.			
*Cushman: CV, CW, CX. For Briggsdale soil in CV, Embry soil in CW, and Terry soil in CX, see their respective series.	20–40	0–4	Fine sandy loam	SC or CL	A–2 or A–6	0–5
		4–21	Clay loam	CL	A–6	0–5
		21–30	Sandy loam	SC	A–2	0–5
		30	Sandstone.			
Danko. Mapped only in an association with Renohill soils.	10–20	0–12	Clay	CH	A–7	0–5
		12–20	Soft alkaline shale.			
*Decross: DE. For Woosley soil in this unit, see Woosley series.	>60	0–4	Loam	MH	A–7	5–10
		4–30	Clay loam	ML or CH	A–7—A–4	5–10
		30–60	Loam	CL	A–6	10–15
Dell. Mapped only in an association with Cloud Peak soils.	40–60	0–6	Loam	CL	A–6	5–15
		6–20	Clay loam	CL	A–6 or A–7	5–15
		20–42	Stony clay loam	GC, CL	A–6	15–20
		42	Fractured limestone.			
*Devoe: DRD. Rock land properties too variable to be estimated.	10–20	0–15	Gravelly loam and gravelly clay loam.	GC	A–6	5–10
		15	Soft shale.			
Embry. Mapped only in associations with Cushman and Gateson soils.	>60	0–60	Sandy loam	SC	A–2 or A–4	0–5
Englewood. Mapped only in an association with Wormser soils.	50–60	0–60	Silty clay and clay	CH	A–7	0–5
*Fort Collins: FcA, FcB, FO, FU. For Ascalon soil in FO and Ulm soil in FU, see their respective series.	>60	0–5	Fine sandy loam	SC	A–6	0–5
		5–21	Clay loam	CL	A–6	0–5
		21–60	Loam	CL	A–6	0–5

significant to engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permea-bility	Available water capacity	Reaction	Salinity	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)							
						In. per hr.	*In. per in. of soil*	*pH*	*Mmhos. per cm. at 25° C.*	
75–85	50–75	40–50	20–30	20–25	NP	2. 0–6. 0	0. 13–0. 15	5. 1–6. 5	<2. 0	Low.
75–85	50–75	40–50	20–30	20–30	5–10	2. 0–6. 0	0. 13–0. 15	5. 1–6. 5	<2. 0	Low.
85–100	85–100	70–100	70–95	40–60	30–40	<0. 06	0. 04–0. 06	7. 9–9. 0+	4. 0–8. 0	High.
75–80	70–75	60–70	50–60	25–35	15–25	0. 6–2. 0	0. 16–0. 18	6. 6–7. 8	<2. 0	Moderate.
75–80	75–80	65–75	50–65	30–40	15–25	0. 6–2. 0	0. 19–0. 21	6. 6–8. 4	<2. 0	Moderate.
60–70	60–70	55–70	50–60	25–35	15–20	0. 6–2. 0	0. 19–0. 21	7. 9–9. 0	<2. 0	Moderate.
80–90	70–80	65–70	50–65	35–40	20–30	0. 6–2. 0	0. 15–0. 17	6. 1–7. 3	<2. 0	Moderate.
30–40	30–40	30–40	25–35	30–40	15–20	0. 6–2. 0	0. 09–0. 11	6. 6–7. 8	<2. 0	Moderate.
30–40	30–40	25–40	20–30	25–30	15–25	0. 6–2. 0	0. 07–0. 09	7. 4–9. 0	<2. 0	Low.
80–100	80–100	70–95	50–75	25–35	15–25	0. 6–2. 0	0. 16–0. 18	7. 4–9. 0	2. 0–15	Moderate.
35–40	30–35	25–35	20–30	20–30	15–20	0. 6–2. 0	0. 15–0. 17	7. 4–9. 0	<2. 0	Low.
90–100	90–100	65–85	35–55	20–25	10–20	2. 0–6. 0	0. 13–0. 15	6. 6–7. 3	<2. 0	Low.
80–100	80–100	70–95	55–80	25–30	15–20	0. 6–2. 0	0. 19–0. 21	6. 6–7. 8	<2. 0	Moderate.
80–100	80–100	50–70	25–35	15–25	5–10	2. 0–6. 0	0. 11–0. 13	7. 9–9. 0	<2. 0	Low.
80–100	80–100	75–100	60–90	50–60	30–40	0. 06–0. 2	0. 14–0. 16	8. 5–9. 0+	2. 0–4. 0	High.
85–90	85–90	80–85	70–80	50–60	10–20	0. 6–2. 0	0. 16–0. 18	6. 1–7. 8	<2. 0	Low.
75–100	75–100	75–100	55–100	40–60	10–30	0. 6–2. 0	0. 19–0. 21	6. 6–7. 8	<2. 0	Moderate.
65–80	60–80	60–65	50–60	30–40	10–20	0. 6–2. 0	0. 19–0. 21	7. 9–8. 4	<2. 0	Moderate.
80–90	80–85	70–80	60–70	30–40	20–30	0. 6–2. 0	0. 16–0. 18	5. 6–7. 3	<2. 0	Moderate.
75–100	75–100	60–100	50–90	35–50	20–30	0. 2–0. 6	0. 19–0. 21	6. 1–7. 8	<2. 0	Moderate.
65–100	60–90	55–90	40–75	30–40	10–20	0. 2–0. 6	0. 19–0. 21	6. 6–9. 0	<2. 0	Low.
65–75	55–65	55–65	40–50	25–35	15–25	0. 6–2. 0	0. 16–0. 18	7. 4–9. 0	<2. 0	Low.
75–100	75–100	45–70	25–40	10–20	5–10	2. 0–6. 0	0. 11–0. 13	5. 6–7. 8	<2. 0	Low.
85–100	85–100	80–100	75–95	50–60	30–40	0. 06–0. 2	0. 14–0. 16	6. 6–8. 4	<2. 0	High.
75–100	75–100	50–85	35–50	25–35	10–20	0. 6–2. 0	0. 13–0. 15	6. 6–7. 8	<2. 0	Low.
75–100	75–100	65–90	50–65	30–40	20–30	0. 6–2. 0	0. 16–0. 18	6. 6–7. 8	<2. 0	Moderate.
75–100	75–100	65–90	50–70	30–40	20–30	0. 6–2. 0	0. 16–0. 18	7. 9–9. 0	<2. 0	Moderate.

TABLE 4.—*Estimated soil properties*

Soil series and map symbols	Depth to bedrock	Depth from surface	Classification: Dominant USDA texture	Classification: Unified	Classification: AASHO	Coarse fraction greater than 3 inches
	In.	*In.*				*Pct.*
Garrett. Mapped only in an association with Maysdorf soils.	>60	0–9	Sandy loam	SC	A–6	0–5
		9–36	Sandy clay loam	SC	A–6	0–5
		36–60	Sandy loam	SC	A–6	0–5
*Gateson: GA. For Embry soil in this unit, see Embry series.	20–40	0–10	Very fine sandy loam	CL	A–6	0–5
		10–24	Clay loam	CL	A–6	5–10
		24	Soft sandstone.			
Gaynor. Mapped only in association with Limon soils and in complexes with Cadoma, Razor, and Samsil soils.	20–40	0–24	Clay	CH	A–7	0–5
		24	Soft shale.			
*Glenberg:						
Gd, GG. For Bankard soil in GG, see Bankard series.	>60	0–60	Sandy loam	SC	A–2	0–5
Ge	>60	0–30	Fine sandy loam	SC	A–2	0–5
		30–60	Sand and loamy sand	SM	A–2	0–5
Gullied land: GU. Properties too variable to be estimated.						
Gystrum. Mapped only in complex with Pokeman and Rekop soils.	20–40	0–10	Silt loam	CL	A–6	0–5
		10–27	Silt loam	CL	A–6	0–5
		27	Soft gypsum rock.			
*Harlan: Ha, HD. For Kirtley soil in HD, see Kirtley series.	40–60	0–8	Loam	CL	A–6	0–5
		8–20	Clay loam	CL	A–6	0–5
		20–60	Loam	CL	A–6	5–10
*Haverson: He, Hf, Hg, HH, HK. For Glenberg soils in HH and HK, see Ge and GG under Glenberg series.	>60	0–60	Loam	CL	A–6	0–5
Haverson, sandy subsoil variant: Hm	>60	0–26	Loam	CL	A–6	0–5
		26–60	Sandy loam	SC	A–2 or A–4	0–5
*Hazton: HN. For Burgess soil in this unit, see Burgess series.	8–20	0–17	Gravelly coarse sandy loam	SM	A–1 or A–2	5–10
		17	Granitic rock.			
Heldt: HoA, HoB, HoC	50–60	0–5	Silty clay loam	CH	A–7	------
		5–60	Clay	CH	A–7	------
Indart: IN	20–40	0–12	Fine sandy loam	SC	A–4	0–5
		12–32	Sandy clay loam	SC	A–6	5–10
		32	Soft sandstone.			
Jenkinson. Mapped only in association with Turk and Lymanson soils.	10–20	0–14	Channery clay loam	CL	A–6	0–5
		14	Hard sandy shale.			
Julesburg: Ju	>60	0–60	Sandy loam	SC	A–2	0–5
Keyner: KCC	>60	0–6	Loamy sand	SC	A–2	0–5
		6–11	Sandy clay loam	SC	A–6	0–5
		11–18	Sandy clay loam	SC	A–6	0–5
		18–60	Fine sandy loam	SC	A–4	0–5

See footnotes at end of table.

significant to engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permea-bility	Available water capacity	Reaction	Salinity	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)							
						In. per hr.	*In. per in. of soil*	*pH*	*Mmhos. per cm. at 25° C.*	
75–100	75–100	50–85	35–50	15–25	10–20	2. 0–6. 0	0. 11–0. 13	6. 6–7. 8	<2. 0	Low.
75–100	75–100	60–90	35–50	25–35	10–20	0. 6–2. 0	0. 14–0. 16	6. 6–7. 8	<2. 0	Low.
75–100	75–100	60–80	35–40	20–30	10–20	2. 0–6. 0	0. 11–0. 13	7. 4–8. 4	<2. 0	Low.
95–100	95–100	85–95	50–65	20–30	10–20	0. 6–2. 0	0. 15–0. 17	5. 6–7. 8	<2. 0	Moderate.
75–100	75–100	65–90	50–65	30–40	15–30	0. 6–2. 0	0. 19–0. 21	5. 1–7. 3	<2. 0	Moderate.
85–100	85–100	70–100	65–95	50–60	30–40	0. 06–0. 2	0. 15–0. 17	7. 9–9. 0	<2. 0–8. 0	High.
85–90	85–90	50–65	25–35	10–20	5–10	2. 0–6. 0	0. 11–0. 13	7. 4–9. 0	[2] <2. 0	Low.
85–90	85–90	50–65	25–35	10–20	5–10	2. 0–6. 0	0. 11–0. 13	7. 9–8. 5	<2. 0	Low.
90–100	90–100	60–80	20–30	5–10	NP	6. 0–20	0. 06–0. 08	7. 9–8. 4	<2. 0	Low.
75–100	75–100	70–95	55–90	25–35	15–25	0. 6–2. 0	0. 19–0. 21	7. 4–9. 0	2. 0–4. 0	Moderate.
75–100	75–100	65–95	50–75	20–30	10–20	0. 6–2. 0	0. 19–0. 21	7. 9–9. 0	2. 0–4. 0	Moderate.
95–100	95–100	85–95	60–75	25–35	15–25	0. 6–2. 0	0. 16–0. 18	6. 6–7. 8	<2. 0	Moderate.
75–100	75–100	70–95	50–80	30–40	20–30	0. 6–2. 0	0. 19–0. 21	6. 6–7. 8	<2. 0	Moderate.
75–95	75–90	65–85	60–75	25–30	15–30	0. 6–2. 0	0. 16–0. 18	7. 9–9. 0	<2. 0	Moderate.
85–100	85–100	70–90	50–70	25–40	10–25	0. 6–2. 0	0. 16–0. 18	7. 4–9. 0	[3] 2. 0–4. 0	Moderate.
95–100	85–95	80–85	65–75	20–40	10–20	0. 6–2. 0	0. 16–0. 18	7. 4–8. 4	2. 0–4. 0	Moderate.
95–100	95–100	60–70	30–40	10–20	5–10	2. 0–6. 0	0. 11–0. 13	7. 9–9. 0	2. 0–4. 0	Low.
75–100	50–100	40–70	15–35	10–20	NP	2. 0–6. 0	0. 11–0. 13	5. 6–7. 8	<2. 0	Low.
95–100	95–100	90–95	85–90	50–60	30–40	0. 2–0. 6	0. 19–0. 21	6. 6–9. 0	2. 0–4. 0	High.
95–100	95–100	95–100	90–95	50–60	30–40	0. 06–0. 2	0. 14–0. 16	7. 4–9. 0	2. 0–4. 0	High.
75–100	75–100	50–85	35–50	20–30	5–10	0. 6–2. 0	0. 13–0. 15	5. 6–6. 5	<2. 0	Low.
75–100	75–100	60–90	35–50	20–30	15–25	0. 6–2. 0	0. 19–0. 21	5. 1–6. 5	<2. 0	Moderate.
70–75	65–70	60–65	50–60	30–40	15–25	0. 6–2. 0	0. 14–0. 16	7. 9–9. 0	<2. 0	Moderate.
75–100	75–100	45–70	20–35	20–30	5–10	2. 0–6. 0	0. 11–0. 13	6. 6–8. 4	<2. 0	Low.
95–100	95–100	50–75	15–30	10–20	5–10	2. 0–6. 0	0. 06–0. 08	7. 4–9. 0	<2. 0	Low.
85–100	85–100	70–90	35–50	25–35	15–25	0. 6–2. 0	0. 14–0. 16	7. 9–9. 0+	<2. 0	Moderate.
75–100	75–100	60–90	35–50	25–35	15–25	0. 2–0. 6	0. 06–0. 08	7. 9–9. 0+	2. 0–8. 0	Moderate.
75–100	75–100	50–85	35–50	15–25	5–10	0. 2–0. 6	0. 06–0. 08	8. 5–9. 0+	2. 0–8. 0	Low.

TABLE 4.—*Estimated soil properties*

Soil series and map symbols	Depth to bedrock	Depth from surface	Classification			Coarse fraction greater than 3 inches
			Dominant USDA texture	Unified	AASHO	
	In.	*In.*				*Pct.*
*Kim: KdA, KdB, KdC, Ke, KH, KT, KZB, KZD. For Haverson soil in KH, see He under Haverson series; for Travessilla soil in KT and Zigweid soils in KZB and KZD, see their respective series.	>60	0-60	Silt loam	CL	A-6	0-5
Kirtley. Mapped only in associations with Moret and Potts soils.	20-40	0-7	Loam	CL	A-6	0-5
		7-22	Clay loam	CL	A-6	0-5
		22-30	Loam	CL	A-6	0-5
		30	Soft shale.			
*La Fonda: LA. For Harlan soil in this unit, see Harlan series.	>60	0-60	Very fine sandy loam	CL	A-6	0-5
*Leavitt: LE. For Passcreek soil in this unit, see Passcreek series.	50-60	0-12	Clay loam and loam	ML or MH	A-7	0-5
		12-60	Clay loam	CL	A-6 or A-7	0-10
*Limon: LmA, LmB, LmC, LnB, LnC, LO, LR. For Cadoma soil in LO and Gaynor soil in LR, see their respective series.	>60	0-60	Silty clay	CH	A-7	----------
Lohmiller: Ls	>60	0-60	Silty clay loam	CL or CH	A-7	----------
*Lohsman: LTD. For Orella soil, see Orella series.	20-40	0-13	Clay	CH	A-7	----------
		13-26	Clay loam	CL	A-6	----------
		26	Soft alkaline shale.			
Lymanson. Mapped only in association with Turk and Jenkinson soils.	20-40	0-10	Loam	ML	A-4	0-10
		10-30	Loam	CL	A-7	5-15
		30	Soft sandstone and shale.			
Mathers. Mapped only in an association with Pineguest soils.	>60	0-7	Gravelly sandy loam	SM	A-4	10-15
		7-27	Gravelly sandy clay loam	SM	A-1	5-10
		27-60	Gravelly sandy loam	SM	A-1	5-10
*Maysdorf: MdB, MdC, MF, MG, MP, MR. For Garrett soil in MG, Pugsley soil in MP, and Schooner soil in MR, see their respective series.	50-60	0-10	Sandy loam	SC	A-2 or A-4	0-5
		10-32	Sandy clay loam	SC or CL	A-6	0-5
		32-60	Fine sandy loam	SC or CL	A-6	0-5
*Moret: MSD, MTD, MU, MV. For Rencalson soil in MSD, Kirtley soil in MU, and Shirk soil in MV, see their respective series. For Rock land in MTD, properties too variable to be estimated.	10-20	0-15	Clay loam	GC or CL	A-6	0-5
		15	Hard shale.			
*Nathrop: NP, NS, NW. For Passcreek soil in NP, Starley soil in NS, and Woosley soil in NW, see their respective series.	20-40	0-7	Stony loam	GC	A-2 or A-6	5-20
		7-28	Stony clay loam	GC	A-2 or A-6	10-20
		28	Hard, fractured limestone.			
Orella. Mapped only in complex with Lohsman soils.	10-20	0-14	Silty clay	CH	A-7	0-5
		14	Soft alkaline shale.			
*Otero: OK. For Kim soil in this unit, see Kim series.	>60	0-42	Sandy loam	SM	A-2 or A-4	0-5
		42-60	Very fine sandy loam	ML or CL	A-4	0-5

See footnotes at end of table.

significant to engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permea-bility	Available water capacity	Reaction	Salinity	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)							
						In. per hr.	*In. per in. of soil*	*pH*	*Mmhos. per cm. at 25° C.*	
85–100	85–100	75–95	60–85	25–35	15–20	0.6–2.0	0.16–0.18	7.4–9.0	[4] 2.0–4.0	Moderate.
85–100	85–100	70–95	50–75	20–40	10–20	0.6–2.0	0.16–0.18	6.6–7.8	<2.0	Low.
85–100	85–100	75–100	60–80	30–40	15–25	0.6–2.0	0.19–0.21	7.4–8.4	<2.0	Moderate.
85–100	85–100	70–95	50–75	20–40	10–20	0.6–2.0	0.16–0.18	7.9–9.0	<2.0	Low.
75–100	75–100	65–95	50–65	20–30	10–20	0.6–2.0	0.15–0.17	6.6–9.0	<2.0	Low.
70–95	65–90	65–70	50–65	45–55	15–25	0.6–2.0	0.19–0.21	6.6–7.8	<2.0	Moderate.
70–95	65–90	65–70	50–65	35–45	15–30	0.6–2.0	0.19–0.21	7.9–9.0	<2.0	Moderate.
75–100	75–100	70–100	55–95	50–60	30–40	0.06–0.2	0.15–0.17	7.9–9.0	[5] 2.0–4.0	High.
75–100	75–100	70–100	60–95	40–60	30–40	0.06–0.2	0.19–0.21	7.8–8.5	<2.0	High.
75–100	75–100	70–100	55–95	50–60	30–40	0.06–0.2	0.07–0.08	5.6–9.0†	2.0–8.0	High.
75–100	75–100	70–100	65–95	30–40	25–35	0.06–0.2	0.09–0.11	8.5–9.0†	2.0–8.0	High.
70–95	70–95	60–90	55–70	30–40	5–10	0.6–2.0	0.19–0.21	7.4–8.4	<2.0	Low.
70–95	70–95	60–90	55–70	40–50	20–35	0.6–2.0	0.19–0.21	7.4–9.0	<2.0	Moderate.
95–100	60–70	55–60	40–50	15–25	0–5	0.6–2.0	0.11–0.13	5.6–6.5	<2.0	Low.
80–85	60–70	30–60	10–20	25–35	0–5	0.6–2.0	0.14–0.16	5.6–7.3	<2.0	Low.
80–85	60–70	20–40	10–20	25–35	NP	2.0–6.0	0.08–0.10	6.1–7.3	<2.0	Low.
95–100	95–100	60–70	30–40	10–20	5–10	2.0–6.0	0.11–0.13	6.6–7.8	<2.0	Low.
95–100	95–100	80–90	35–55	30–40	20–30	0.6–2.0	0.14–0.16	6.6–9.0	<2.0	Moderate.
95–100	95–100	70–85	40–55	25–35	15–25	2.0–6.0	0.13–0.15	7.9–9.0	<2.0	Low.
50–100	50–100	45–100	40–80	30–40	15–20	0.6–2.0	0.19–0.21	6.6–7.8	<2.0	Moderate.
50–75	50–75	45–65	30–50	25–35	10–15	0.6–2.0	0.16–0.18	6.6–7.8	<2.0	
35–50	35–50	30–45	25–40	30–40	15–20	0.6–2.0	0.13–0.15	6.6–9.0	<2.0	Moderate.
95–100	95–100	90–100	90–95	50–60	30–40	<0.06	0.07–0.08	7.4–9.0†	2.0–4.0	High.
95–100	95–100	60–70	30–40	10–20	NP	2.0–6.0	0.11–0.13	6.6–9.0	<2.0	Low.
95–100	95–100	85–95	50–65	15–25	5–10	2.0–6.0	0.15–0.17	7.9–9.0	<2.0	Low.

TABLE 4.—*Estimated soil properties*

Soil series and map symbols	Depth to bedrock	Depth from surface	Classification: Dominant USDA texture	Classification: Unified	Classification: AASHO	Coarse fraction greater than 3 inches
	In.	*In.*				*Pct.*
*Passcreek: PA. For Slipman and Sublette soils in this unit, see their respective series.	20–40	0–11 11–23 23	Clay loam Channery loam Sandstone.	CL GC or SC	A–6 A–6	5–10 5–10
*Petrie: Pc, PE. For Bone soil in PE, see Bone series.	>60	0–60	Clay and silty clay	CH	A–7	0–5
*Pineguest: PG. For Mathers soil in this unit, see Mathers series.	40–60	0–15 15–26 26–60	Gravelly coarse loamy sand Gravelly coarse sandy loam Gravelly coarse sand	SM SC SM	A–1 A–2 A–1	0–5 5–10 5–10
*Pokeman: PKD. For Gystrum and Rekop soils in this unit, see their respective series.	20–40	0–30 30	Clay loam Soft gypsum rock.	CL	A–6	0–5
*Poker: PM. For Bachus and Splitro soils in this unit, see their respective series.	20–40	0–30 30	Sandy loam Hard sandstone.	SC	A–2	0–5
*Potts: PS, PT. For Kim soil in PS and Kirtley soil in PT, see their respective series.	>60	0–7 7–16 16–60	Loamy Clay loam Loam	ML or CL CL ML or CL	A–4 A–6 A–4	0–5 0–5 0–5
*Pugsley: PU, PXD. For Gateson soil in PU and Southfork soil in PXD, see their respective series.	20–40	0–7 7–24 24	Sandy loam Sandy clay loam Soft sandstone.	SC SC	A–2 A–6	0–5 0–5
*Razor: RAD. For Gaynor and Samsil soils in this unit, see their respective series.	20–40	0–24 24	Silty clay Soft shale.	CH	A–7	0–5
Redbank. Mapped only in an association with Barnum soils.	>60	0–60	Fine sandy loam	SC	A–4	0–5
Rekop. Mapped only in a complex with Pokeman and Gystrum soils.	10–20	0–19 19	Gravelly loam Soft gypsum rock.	GM, ML, or CL	A–4	5–10
Rencalson. Mapped only in complex with Moret soils.	20–40	0–32 32	Clay loam Soft shale.	CL	A–7	0–5
*Renohill: RcB, RcC, RD, REC, RED. For Danko soil in RD and Razor soils in REC and RED, see their respective series.	20–40	0–30 30	Clay loam Soft shale.	CL	A–7	0–5
*Rhoame: RhB, RhC, RM, RND. For Moret soil in RND, see Moret series.	>60	0–8 8–60	Channery clay loam Channery clay	CL CL or CH	A–6 or A–7 A–7	0–5 0–5
Rock land: RO. Properties too variable to be estimated.						
Rock outcrop. Properties too variable to be estimated. Mapped only with other soils.						
Saline, wet land: SA. Properties too variable to be estimated.						

See footnotes at end of table.

significant to engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)							
						In. per hr.	*In. per in. of soil*	*pH*	*Mmhos. per cm. at 25° C.*	
80–90	75–80	70–80	50–65	30–40	15–20	0.6–2.0	0.19–0.21	6.6–7.8	<2.0	Moderate.
65–75	65–75	55–65	40–50	30–40	15–20	0.6–2.0	0.19–0.21	7.4–8.4	<2.0	Moderate.
95–100	95–100	90–100	75–95	50–60	30–40	<0.06	0.07–0.08	8.5–9.0	2.0–8.0	High.
60–80	50–75	25–40	10–15	15–20	NP	6.0–20	0.07–0.09	5.6–6.5	<2.0	Low.
60–80	50–75	30–50	15–30	20–30	5–10	2.0–6.0	0.11–0.13	5.6–6.5	<2.0	Low.
60–80	50–75	25–40	0–5	NP	NP	6.0–20	0.03–0.05	5.6–6.5	<2.0	Low.
75–100	75–100	70–100	50–80	30–40	20–30	0.6–2.0	0.19–0.21	6.6–9.0	2.0–4.0	Moderate.
75–90	75–90	45–65	20–35	20–30	5–10	2.0–6.0	0.11–0.13	6.6–7.8	<2.0	Low.
75–100	75–100	65–95	50–75	25–30	5–10	0.6–2.0	0.16–0.18	6.6–7.8	<2.0	Moderate.
75–100	75–100	65–95	50–75	30–40	15–20	0.6–2.0	0.19–0.21	6.6–8.4	<2.0	Moderate.
75–100	75–100	65–95	50–75	25–30	5–10	0.6–2.0	0.16–0.18	7.9–9.0	<2.0	Moderate.
75–100	75–100	50–70	25–35	15–25	5–10	2.0–6.0	0.11–0.13	6.1–7.8	<2.0	Low.
75–100	75–100	70–90	35–50	30–40	15–20	2.0–6.0	0.14–0.16	6.6–7.3	<2.0	Moderate.
75–100	75–100	70–100	70–95	50–60	30–40	0.06–0.2	0.15–0.17	7.4–9.0	2.0–4.0	High.
75–100	75–100	50–85	35–50	10–20	5–10	2.0–6.0	0.11–0.13	7.4–9.0	2.0–4.0	Low.
65–90	65–90	55–85	40–70	20–35	5–10	0.6–2.0	0.11–0.13	7.9–9.0	2.0–4.0	Moderate.
75–100	75–100	70–100	55–80	40–45	20–25	0.06–0.2	0.19–0.21	5.6–7.8	<2.0	High.
75–100	75–100	70–100	55–80	40–45	20–25	0.06–0.02	0.19–0.21	6.6–9.0	<2.0	High.
65–75	65–75	60–75	50–60	35–45	15–25	0.2–0.6	0.17–0.19	5.6–7.8	<2.0	Moderate.
65–75	65–75	60–75	50–70	45–55	30–40	0.06–0.2	0.14–0.16	5.6–7.8	<2.0	Moderate.

TABLE 4.—*Estimated soil properties*

Soil series and map symbols	Depth to bedrock	Depth from surface	Classification: Dominant USDA texture	Classification: Unified	Classification: AASHO	Coarse fraction greater than 3 inches
	In.	*In.*				*Pct.*
*Samsil: SCD, SDE, SE. For Gaynor and Cadoma soils in SCD and Renohill soil in SE, see their respective series. For Shale outcrop in SDE, properties too variable to be estimated.	8–20	0–13 13	Silty clay Shale.	CH	A–7	0–5
*Sanford: SF. For Wetterhorn soil in this unit, see Wetterhorn series.	20–40	0–13 13–24 24	Fine sandy loam Loamy sand Soft sandstone.	SC SM	A–2 or A–4 A–1 or A–2	0–5 0–5
Sawcreek. Mapped only in an association with Tripit soils.	20–40	0–30 30	Sandy loam Soft sandstone.	SC	A–2	0–5
Schooner. Mapped only in an association with Maysdorf soils.	10–20	0–14 14	Fine sand Hard sandstone.	SM	A–2	0–5
Shale outcrop: SH. Properties too variable to be estimated.						
Shale rock land: SK. Properties too variable to be estimated.						
*Shingle: Sm, SNa, SNb, SNc, SNd, SNe, SNf. For Briggsdale soil in SNa, Cushman soil in SNb, Kim soils in SNc and SNd, Tassell soil in SNe, and Worf in SNf, see their respective series.	8–20	0–14 14	Loam Soft shale and siltstone.	CL	A–6	0–5
Shirk. Mapped in associations with Moret and Wormser soils.	20–40	0–26 26	Clay loam Fractured platy shale.	CL	A–6	------------
*Simmont: SOE. Rock outcrop properties too variable to be estimated.	20–40	0–22 22	Sandy clay loam Hard sandstone.	SC	A–2	65–85
Slipman. Mapped only in associations with Passcreek and Sublette soils.	50–60	0–16 16–27 27–52 52	Sandy loam Loamy fine sand Sandy clay loam Hard sandstone.	SC SM SC	A–2 A–1 or A–2 A–2 or A–6	5–10 5–10 5–10
Slocum. Mapped only in association with Auzqui soils.	>60	0–12 12–60	Clay loam Clay loam	ML CL	A–4 A–6	5–10 5–10
Southfork. Mapped only in complex with Pugsley soils.	10–20	0–15 15	Coarse sandy loam Sandstone.	SM	A–1 or A–2	0–5
*Spearfish: SPE. Shale outcrop properties too variable to be estimated.	8–20	0–17 17	Very fine sandy loam Soft siltstone and sandstone.	SC or CL	A–4	5–10
Splitro. Mapped only in associations with Poker and Bachus soils.	10–20	0–16 16	Sandy loam Hard sandstone.	SC	A–2	5–10
*Starley: SRE. Rock outcrop properties too variable to be estimated.	8–20	0–16 16	Cobbly clay loam Hard fractured limestone.	GC	A–2 to A–6	35–55

See footnotes at end of table.

significant to engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permea-bility	Available water capacity	Reaction	Salinity	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)							
						In. per hr.	*In. per in. of soil*	*pH*	*Mmhos. per cm. at 25° C.*	
75–100	75–100	70–100	70–90	50–60	30–40	0. 06–0. 2	0. 15–0. 17	7. 4–9. 0	2. 0–4. 0	High.
75–100 75–100	75–90 75–90	50–75 40–70	30–50 15–30	20–25 10–20	5–10 0–5	2. 0–6. 0 2. 0–6. 0	0. 11–0. 13 0. 06–0. 08	5. 6–6. 5 5. 6–7. 3	<2. 0 <2. 0	Low. Low.
75–100	75–100	50–70	25–35	20–25	5–10	2. 0–6. 0	0. 11–0. 13	6. 1–7. 3	<2. 0	Low.
75–100	75–100	50–80	15–35	NP	NP	6. 0–20	0. 06–0. 08	5. 6–7. 8	<2. 0	Low.
75–100	75–100	65–95	50–80	20–30	10–15	0. 6–2. 0	0. 16–0. 18	7. 4–9. 0	<2. 0	Low.
70–100	70–100	65–95	50–75	30–40	15–20	0. 6–2. 0	0. 16–0. 18	6. 1–7. 8	<2. 0	Moderate.
75–80	60–75	50–60	25–35	30–35	15–20	0. 6–2. 0	0. 07–0. 09	6. 6–7. 8	<2. 0	Moderate.
90–95 80–90 70–80	90–95 80–90 65–70	55–65 40–60 50–65	30–35 15–30 20–40	15–25 5–10 30–40	5–10 NP 15–20	2. 0–6. 0 6. 0–20 0. 6–2. 0	0. 11–0. 13 0. 09–0. 11 0. 14–0. 16	6. 1–6. 5 6. 1–7. 3 6. 6–7. 3	<2. 0 <2. 0 <2. 0	Low. Low. Moderate.
70–80 70–80	70–80 70–80	65–80 65–80	50–65 50–65	30–40 30–40	5–10 15–25	0. 6–2. 0 0. 6–2. 0	0. 19–0. 21 0. 19–0. 21	6. 6–7. 8 6. 6–7. 8	<2. 0 <2. 0	Low. High.
75–100	75–100	45–70	20–35	15–20	NP	2. 0–6. 0	0. 11–0. 13	6. 6–7. 8	<2. 0	Low.
70–100	70–100	60–95	40–60	20–25	5–10	0. 6–2. 0	0. 15–0. 17	7. 9–9. 0	<2. 0	Low.
60–90	60–80	40–60	20–30	15–25	5–10	2. 0–6. 0	0. 11–0. 13	6. 1–7. 8	<2. 0	Low.
50–60	40–50	35–50	30–40	30–40	15–30	0. 6–2. 0	0. 13–0. 15	7. 4–9. 0	<2. 0	Moderate.

TABLE 4.—*Estimated soil properties*

Soil series and map symbols	Depth to bedrock	Depth from surface	Classification: Dominant USDA texture	Classification: Unified	Classification: AASHO	Coarse fraction greater than 3 inches
	In.	*In.*				*Pct.*
*Stoneham: SsA, SsB, SsC, STa, STb, STc, STd, STe, STf, STg. For Absted soil in STa, Ascalon soil in STb, Cragola soil in STc, Cushman soil in STd, Fort Collins soil in STe, Kim soil in STf, and Zigweid soil in STg, see their respective series.	>60	0–30	Clay loam	CL	A-6	0–5
		30–60	Loam	CL	A-6	0–5
*Stubbs: SU. For Turk soil in this unit, see Turk series.	20–40	0–14	Loam	ML	A-4	5–10
		14–32	Clay loam	CL	A-6 or A-7	5–10
		32	Soft shale.			
Sublette. Mapped only in associations with Passcreek and Slipmen soils.	>60	0–25	Sandy loam	SM	A-2	5–10
		25–60	Sandy loam	SC	A-2	5–10
*Sunup: SVE, SW. For Carnero soil in SW, see Carnero series. Rock outcrop, in SVE, properties too variable to be estimated.	10–20	0–14	Channery clay loam	GM or GC	A-2	25–30
		14	Hard shale and sandstone.			
Tassel. Mapped only in an association with Terry soils.	8–20	0–17	Sandy loam	SM	A-1 or A-2	0–5
		17	Soft sandstone.			
*Terry: TE. For Tassel soil in this unit, see Tassel series.	20–40	0–36	Fine sandy loam	SC	A-4	0–5
		36	Soft sandstone.			
*Tolman. Mapped only in an association with Bayerton soils.	10–20	0–7	Very stony loam	SC	A-2	15–20
		7–16	Very gravelly clay loam	SC	A-2	30–50
		16	Hard sandstone.			
*Travessilla: TRE. Rock outcrop properties too variable to be estimated.	10–20	0–12	Sandy loam	SC	A-2	5–10
		12	Hard sandstone.			
*Tripit: TS, TT. For Devoe soil in TS and Sawcreek soil in TT, see their respective series.	20–40	0–8	Loam	ML	A-4	0–5
		8–30	Clay loam	GC	A-2 or A-6	0–5
		30	Soft shale.			
*Turk: TU. For Lymanson and Jenkinson soils in this unit, see their respective series.	20–40	0–36	Clay	CH	A-7	0–5
		36	Soft shale.			
*Ulm: UlA, UlB, UM, UW. For Cushman soil in UM and Wyarno soil in UW, see their respective series.	>60	0–7	Clay loam	ML	A-4	0–5
		7–18	Clay loam	CL	A-6 or A-7	0–5
		18–60	Clay loam	CL	A-6	0–5
*Valent: VC. For Cushman soil in this unit, see Cushman series.	>60	0–60	Fine sand	SM	A-2	0–5
Wetterhorn. Mapped only in an association with Sanford soils.	20–40	0–10	Very fine sandy loam	ML or CL	A-4	0–5
		10–20	Clay loam	CL	A-6	5–10
		20–36	Stony clay loam	CL	A-6	10–15
		36	Soft sandstone.			
*Wolf: WC. For Cragola soil in this unit, see Cragola series.	>60	0–14	Clay loam	CL	A-6	0–5
		14–60	Gravelly clay loam	GC or CL	A-6	5–10

See footnotes at end of table.

significant to engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permea-bility	Available water capacity	Reaction	Salinity	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)							
						In. per hr.	*In. per in. of soil*	*pH*	*Mmhos. per cm. at 25° C.*	
75–100	75–100	70–100	50–80	35–40	15–30	0. 6–2. 0	0. 19–0. 21	6. 6–9. 0	<2. 0	Moderate.
75–100	75–100	65–95	50–75	25–35	15–20	0. 6–2. 0	0. 15–0. 17	7. 9–9. 0	<2. 0	Moderate.
80–100	75–100	65–90	50–75	30–35	5–10	0. 6–2. 0	0. 16–0. 18	6. 1–7. 8	<2. 0	Moderate.
80–100	75–100	70–95	55–80	35–40	15–20	0. 6–2. 0	0. 19–0. 21	6. 6–9. 0	<2. 0	Moderate.
65–85	65–85	40–60	20–35	30–40	5–10	2. 0–6. 0	0. 11–0. 13	6. 6–7. 8	<2. 0	Low.
65–85	65–85	40–60	20–35	20–30	5–10	2. 0–6. 0	0. 11–0. 13	6. 6–7. 8	<2. 0	Low.
10–50	10–50	10–50	10–35	25–35	5–10	0. 6–2. 0	0. 15–0. 17	7. 9–9. 0	<2. 0	Moderate.
75–100	75–100	45–75	20–35	15–20	NP	2. 0–6. 0	0. 11–0. 13	7. 4–9. 0	<2. 0	Low.
75–100	75–90	50–75	35–50	15–25	5–10	2. 0–6. 0	0. 11–0. 13	6. 6–9. 0	<2. 0	Low.
70–80	40–50	35–40	30–35	20–30	5–10	0. 6–2. 0	0. 18–0. 20	5. 6–7. 8	<2. 0	Low.
70–80	40–50	35–40	30–35	20–30	10–20	0. 6–2. 0	0. 16–0. 18	5. 6–7. 8	<2. 0	Moderate.
75–95	75–85	45–60	20–35	15–20	5–10	6. 0–20	0. 11–0. 13	7. 4–9. 0	<2. 0	Low.
75–95	70–85	60–80	45–65	30–40	5–10	0. 6–2. 0	0. 16–0. 18	6. 6–7. 8	<2. 0	Moderate.
50–80	40–70	35–65	30–50	30–40	15–20	0. 6–2. 0	0. 19–0. 21	6. 6–8. 4	<2. 0	Moderate.
95–100	95–100	95–100	80–95	55–70	30–40	0. 06–0. 2	0. 14–0. 16	6. 6–9. 0	<2. 0	High.
95–100	95–100	80–100	70–80	35–40	5–10	0. 6–2. 0	0. 19–0. 21	6. 6–7. 8	<2. 0	Moderate.
75–100	75–100	75–100	50–80	40–45	20–25	0. 6–2. 0	0. 19–0. 21	6. 6–7. 8	<2. 0	High.
75–100	75–100	75–100	50–80	35–40	15–20	0. 6–2. 0	0. 19–0. 21	7. 9–9. 0	<2. 0	Moderate.
95–100	95–100	65–80	20–30	5–10	NP	6. 0–20	0. 05–0. 07	6. 6–7. 8	<2. 0	Low.
90–100	90–100	80–90	50–60	15–25	5–10	0. 6–2. 0	0. 15–0. 17	5. 6–7. 3	<2. 0	Low.
85–95	85–90	80–85	60–70	35–40	15–20	0. 2–0. 6	0. 19–0. 21	5. 6–6. 5	<2. 0	Moderate.
60–85	55–85	50–80	50–80	40–55	20–30	0. 2–0. 6	0. 19–0. 21	5. 6–7. 3	<2. 0	Moderate.
75–100	75–100	60–90	50–65	30–40	15–25	0. 6–2. 0	0. 19–0. 21	6. 6–8. 4	<2. 0	Moderate.
60–75	60–75	55–70	45–60	30–40	15–25	0. 6–2. 0	0. 14–0. 16	7. 9–9. 0	<2. 0	Moderate.

TABLE 4.—*Estimated soil properties*

Soil series and map symbols	Depth to bedrock	Depth from surface	Classification: Dominant USDA texture	Unified	AASHO	Coarse fraction greater than 3 inches
	In.	*In.*				*Pct.*
Woosley. Mapped only in an association with Decross soils.	20–40	0–12	Loam	ML	A–7	5–10
		12–26	Clay loam	CL	A–6	5–10
		26–35	Loam	CL	A–6	10–20
		35	Hard limestone.			
Worf. Mapped only in associations with Briggsdale and Shingle soil.	10–20	0–14	Loam	ML	A–4	0–5
		14	Shale and loamstone.			
*Wormser: WE, WM. For Englewood soil in WE and Shirk soil in WM, see their respective series.	20–40	0–25	Clay loam	CL	A–6 or A–7	0–5
		25	Soft shale.			
*Wyarno: WnA, WnB, WO, WY. For Limon soil in WO and Stoneham soil in WY, see their respective series.	>60	0–60	Clay loam or clay	CL or CH	A–7	0–5
*Zigweid: ZgA, ZgB, ZKD. For Keyner soil in ZKD, see Keyner series.	>60	0–60	Loam	CL	A–6	0–5

[1] NP=nonplastic.
[2] Salinity for Glenberg soil in HK is 2.0–15.
[3] Salinity for Haverson soil in HK is 2.0–15.

TABLE 5.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in this series is made up of two or more kinds of soil. The soil tions for referring to other series that

Soil series and map symbols	Suitability as source of—: Topsoil	Sand and gravel	Road fill	Soil features affecting—: Irrigation
*Absted: Aa, AB, ADB, ADC. For Bone soil in AB and Wyarno soils in ADB and ADC, see their respective series.	Poor: clay	Unsuited	Poor: high shrink-swell potential.	Very strongly alkaline; moderate salinity.
Alluvial land: AL. No interpretations made. Properties too variable.				
*Amsden: AM. For Decross soil in this unit, see Decross series.	Fair: clay loam	Unsuited	Fair: moderate shrink-swell potential.	([1])
*Ascalon: AS. For Julesburg soil in this unit, see Julesburg series.	Good to fair: slopes of 3 to 15 percent.	Unsuited	Moderate: moderate shrink-swell potential.	Moderate permeability; high available water capacity.
*Auzqui: AU. For Slocum soil in this unit, see Slocum series.	Fair: slopes of 6 to 15 percent.	Unsuited	Poor: high frost-action potential.	([1])

See footnotes at end of table.

significant to engineering—Continued

Percentage less than 3 inches passing sieve—				Liquid limit	Plasticity index	Permea-bility	Available water capacity	Reaction	Salinity	Shrink-swell potential
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)							
						In. per hr.	*In. per in. of soil*	*pH*	*Mmhos. per cm. at 25° C.*	
95-100	95-100	90-95	80-90	40-50	10-15	0. 6-2. 0	0. 19-0. 21	6. 1-7. 3	<2. 0	Low.
75-100	75-100	70-85	50-70	30-40	20-30	0. 6-2. 0	0. 19-0. 21	6. 6-7. 8	<2. 0	Moderate.
60-70	60-70	55-60	50-55	30-40	10-20	0. 6-2. 0	0. 19-0. 21	7. 9-9. 0	<2. 0	Moderate.
75-100	75-100	65-95	50-65	30-35	5-10	0. 6-2. 0	0. 16-0. 18	6. 6-9. 0	<2. 0	Moderate.
70-95	70-95	65-90	50-75	35-45	15-20	0. 2-0. 6	0. 19-0. 21	6. 1-9. 0	<2. 0	High.
75-100	75-100	65-95	60-80	40-60	25-35	0. 2-0. 6	0. 19-0. 21	6. 6-9. 0	<2. 0	High.
75-90	75-90	65-85	50-70	25-35	15-20	0. 6-2. 0	0. 16-0. 18	7. 4-9. 0	2. 0-4. 0	Moderate.

[4] Salinity for Ke is 8.0-15.
[5] Salinity for LnB and LnC is 8.0-15.

interpretations of the soils

in such mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instruc- appear in the first column of this table]

Soil features affecting—Continued			Degree and kind of limitation for—		
Drainage for crops and pasture	Pond reservoir areas	Embankments	Dwellings with basements	Septic tank absorption fields	Local roads and streets
Slow permeability	Slopes 0 to 10 percent.	Low shear strength; low permeability when compacted; low piping hazard.	Severe: high shrink-swell potential.	Severe: slow permeability.	Severe: high shrink-swell potential.
(1)	Slopes of 6 to 15 percent.	Medium or low shear strength; low permeability when compacted.	Moderate: moderate frost-action potential.	Moderate: slopes of 6 to 15 percent; moderate permeability.	Moderate: moderate shrink-swell potential.
Moderate pemeability.	Slopes of 3 to 15 percent.	Medium shear strength; low permeability when compacted.	Moderate: moderate shrink-swell potential.	Moderate: slopes of 3 to 15 percent.	Moderate: moderate shrink-swell potential.
(1)	Slopes of 6 to 15 percent.	Low shear strength; low permeability when compacted.	Severe: high frost-action potential.	Moderate; slopes of 6 to 15 percent.	Poor: high frost-action potential.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Irrigation
Bachus. Mapped only in an association with Poker and Splitro soils.	Fair to poor: slopes of 6 to 20 percent; bedrock at depth of 20 to 40 inches.	Unsuited	Poor: bedrock at depth of 20 to 40 inches.	(1)
Badland: BA. No interpretations made. Properties too variable.				
Bankard: Bd	Poor: sand	Poor: fines; stratified in many places.	Good	Low available water capacity; high intake rate; rapid permeability; moderate salinity.
*Barnum: Be, BK. For Redbank soil in BK, see Redbank series.	Fair: moderate salinity.	Unsuited	Fair: moderate shrink-swell potential.	High wind erosion hazard; moderate salinity.
Barnum, sandy subsoil variant: Bf	Good	Unsuited	Fair: moderate shrink-swell potential.	High wind erosion hazard; high available water capacity.
*Bayerton: BM. For Tolman soil in this unit, see Tolman series.	Poor: slopes of 10 to 30 percent.	Unsuited	Poor: slopes of 10 to 30 percent; bedrock at depth of 20 to 40 inches.	(1)
Bidman. Mapped only in complex with Briggsdale soil.	Poor: clay	Unsuited	Poor: high shrink-swell potential.	High available water capacity; slopes of 6 to 10 percent.
*Big Horn: BN. For Wolf soil in this unit, see Wolf series.	Poor: clayey and gravelly.	Unsuited	Poor: high shrink-swell potential.	High available water capacity; good internal drainage.
Bone. Mapped only in complexes with Absted and Petrie soils.	Poor: strongly alkaline; silty clay loam to clay.	Unsuited	Poor: high shrink-swell potential.	Strongly alkaline; silty clay loam to clay.
*Briggsdale: BoB, BoC, BRD, BSD, BT, BU, BWD, BWE. For Bidman soil in BRD, Lohsman soil in BSD, Pugsley soil in BT, Renohill soil in BU, and Worf soils in BWD and BWE, see their respective series.	Fair: clay loam; slopes of 0 to 15 percent.	Unsuited	Poor: bedrock at depth of 20 to 40 inches.	Bedrock at depth of 20 to 40 inches; slopes of 0 to 15 percent.
Burgess. Mapped only in an association with Hazton soils.	Poor to fair: gravelly coarse sandy loam.	Poor: high percentage of fines; low percentage of coarse materials.	Poor: bedrock at depth of 20 to 40 inches.	(1)
Cadoma. Mapped only in association with Limon soils and in complexes with Samsil and Gaynor soils.	Poor: strongly or very strongly alkaline; silty clay.	Unsuited	Poor: high shrink-swell potential.	Bedrock at depth of 20 to 40 inches; strongly or very strongly alkaline.
Carnero. Mapped only in association with Sunup soils.	Fair or poor: clay loam; slopes of 10 to 30 percent.	Unsuited	Poor: bedrock at depth of 22 to 30 inches.	(1)

See footnotes at end of table.

interpretations of the soils—Continued

Soil features affecting—Continued			Degree and kind of limitation for—		
Drainage for crops and pasture	Pond reservoir areas	Embankments	Dwellings with basements	Septic tank absorption fields	Local roads and streets
(1)	Bedrock at depth of 20 to 40 inches; slopes of 6 to 20 percent.	Medium shear strength; medium permeability when compacted.	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Moderate: moderate frost-action potential.
Rapid permeability; banks unstable.	Rapid permeability	Medium shear strength; low permeability when compacted; medium piping hazard.	Severe: occasional flooding.	Severe: occasional flooding.	Severe: occasional flooding.
Moderate permeability; banks very unstable.	Moderate permeability.	Low shear strength; low permeability when compacted.	Severe: occasional flooding.	Severe: occasional flooding.	Severe: occasional flooding.
Banks unstable; tile unstable.	Moderately rapid permeability; seasonal water table below depth of 40 inches.	Low shear strength; low permeability when compacted.	Severe: occasional flooding.	Severe: occasional flooding.	Severe: occasional flooding.
(1)	Slopes of 10 to 30 percent; bedrock at depth of 20 to 40 inches.	Medium shear strength; low permeability when compacted.	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches; slopes of 10 to 30 percent.	Moderate or severe: slopes of 10 to 30 percent.
Moderately slow permeability.	Slopes of 6 to 10 percent.	Low shear strength; low permeability when compacted.	Severe: high shrink-swell potential.	Severe: moderately slow permeability.	Severe: high shrink-swell potential.
Moderately slow permeability.	Gravelly below depth of 26 inches.	Medium shear strength; low permeability when compacted.	Severe: high shrink-swell potential.	Severe: moderately slow permeability.	Severe: high shrink-swell potential
Very slow permeability.	Slopes of 0 to 10 percent; very slow permeability.	Low shear strength; low permeability when compacted.	Severe: high shrink-swell potential.	Severe: very slow permeability.	Severe: high shrink-swell potential.
Bedrock at depth of 20 to 40 inches.	Bedrock at depth of 20 to 40 inches; slopes of 0 to 15 percent.	Low shear strength; low permeability when compacted.	Moderate: moderate shrink-swell potential.	Severe: slope; bedrock at depth of 20 to 40 inches.	Severe: very plastic.
(1)	Slopes of 10 to 20 percent; moderately rapid permeability.	Medium shear strength; low permeability when compacted.	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Moderate to severe: bedrock at depth of 20 to 40 inches; slopes of 10 to 20 percent.
Very slow permeability.	Slopes of 3 to 20 percent; bedrock at depth of 20 to 40 inches.	Low shear strength; low permeability when compacted.	Severe: bedrock at depth of 20 to 40 inches; high shrink-swell potential.	Severe: very slow permeability; bedrock at depth of 20 to 40 inches.	Severe: high shrink-swell potential.
(1)	Slopes of 10 to 30 percent; bedrock at depth of 22 to 30 inches.	Low shear strength; low permeability when compacted.	Severe: bedrock at depth of 22 to 30 inches.	Severe: bedrock at depth of 22 to 30 inches.	Moderate or severe: bedrock at depth of 22 to 30 inches; slopes of 10 to 30 percent.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Irrigation
*Cloud Peak: CD For Dell soil in this unit, see Dell series.	Poor: stony silty clay loam.	Unsuited	Poor: bedrock at depth of 20 to 40 inches.	(1)
Colluvial land: CE. No interpretations made. Properties too variable.				
*Connerton: CnA, CnB, CnC, CnD, CR, CS For La Fonda soil in CR and Spearfish soil in CS, see their respective series.	Good to poor: slopes of 0 to 30 percent.	Unsuited	Fair or poor: moderate shrink-swell potential; slopes of 0 to 30 percent.	High available water capacity; slopes of 0 to 30 percent.
Co	Poor: soluble salts restrict plant growth.	Unsuited	Fair: moderate shrink-swell potential; somewhat poorly drained.	Somewhat poorly drained; slopes of 0 to 10 percent.
*Cragola: CT, CU For Ascalon soil in CT and Shingle soil in CU, see their respective series.	Poor: very gravelly clay loam.	Unsuited	Poor: bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches.
*Cushman: CV, CW, CX For Briggsdale soil in CV, Embry soil in CW, and Terry soil in CX, see their respective series.	Fair or poor: slopes of 6 to 20 percent.	Unsuited	Poor: bedrock at depth of 20 to 40 inches.	Low to moderate available water capacity; bedrock at depth of 20 to 40 inches; slopes of 6 to 20 percent.
Danko Mapped only in an association with Renohill soils.	Poor: clay	Unsuited	Poor: high shrink-swell potential.	Shale at depth of 10 to 20 inches; very strongly alkaline.
*Decross: DE For Woosley soil in this unit, see Woosley series.	Fair: slopes of 6 to 15 percent; clay loam.	Unsuited	Fair: moderate shrink-swell potential.	(1)
Dell Mapped only in an association with Cloud Peak soils.	Fair to poor: slopes of 6 to 20 percent.	Unsuited to poor: limestone fragments below depth of 20 inches; high percentage of fines.	Fair: moderate shrink-swell potential.	(1)
*Devoe: DRD For Rock land in this unit, no interpretations made. Properties too variable.	Poor: slopes of 10 to 40 percent; gravelly.	Unsuited	Poor: bedrock at depth of 10 to 20 inches.	(1)
Embry Mapped only in associations with Cushman and Gateson soils.	Fair: slopes of 6 to 20 percent.	Unsuited	Good or fair: slopes of 6 to 20 percent.	Moderate to high available water capacity.

See footnotes at end of table.

interpretations of the soils—Continued

Soil features affecting—Continued			Degree and kind of limitation for—		
Drainage for crops and pasture	Pond reservoir areas	Embankments	Dwellings with basements	Septic tank absorption fields	Local roads and streets
(1)	Slopes of 6 to 30 percent; bedrock at depth of 20 to 40 inches.	Medium shear strength; low permeability when compacted.	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Moderate to severe: bedrock at depth of 20 to 40 inches; slopes of 6 to 30 percent.
Slopes of 0 to 30 percent; walls of cuts are unstable.	Moderate permeability; slopes of 0 to 30 percent.	Low shear strength; medium piping hazard.	Moderate to severe: moderate shrink-swell potential; slopes of 0 to 30 percent.	Slight where slopes are 0 to 8 percent. Moderate where slopes are 8 to 15 percent. Severe where slopes are 15 to 30 percent.	Moderate or severe: moderate shrink-swell potential.
Slopes of 0 to 10 percent; walls of cuts unstable.	Slopes of 0 to 10 percent.	Low shear strength; medium piping hazard.	Severe: somewhat poorly drained.	Severe: water table above depth of 48 inches.	Moderate: moderate shrink-swell potential; somewhat poorly drained.
Bedrock at depth of 10 to 20 inches.	Slopes of 10 to 40 percent; bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.
Bedrock at depth of 20 to 40 inches.	Slopes of 6 to 20 percent; moderate permeability; bedrock at depth of 20 to 40 inches.	Medium shear strength; low permeability when compacted.	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Moderate or severe: bedrock at depth of 20 to 40 inches; slopes of 6 to 20 percent.
Slow permeability.	Shale at depth of 10 to 20 inches; slopes of 10 to 30 percent.	Low shear strength; low permeability when compacted; bedrock at depth of 10 to 20 inches.	Severe: shale at depth of 10 to 20 inches; high shrink-swell potential.	Severe: slow permeability.	Severe: shale at depth of 10 to 20 inches.
(1)	Slopes of 6 to 15 percent.	Low shear strength; low permeability when compacted.	Moderate: moderate shrink-swell potential.	Moderate: moderate permeability; slopes of 6 to 15 percent.	Moderate: moderate potential frost action.
(1)	Slopes of 6 to 20 percent; bedrock at depth of 40 to 60 inches.	Medium shear strength; low permeability when compacted.	Moderate: moderate shrink-swell potential.	Severe: moderately slow permeability; bedrock at depth of 40 to 60 inches.	Moderate: moderate potential frost action.
(1)	Slopes of 10 to 40 percent; bedrock at depth of 10 to 20 inches.	Medium shear strength.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.
Moderately rapid permeability.	Moderately rapid permeability; slopes of 6 to 20 percent.	Medium shear strength; low permeability when compacted.	Moderate: slopes of 6 to 20 percent.	Moderate to severe: slopes of 6 to 20 percent.	Moderate to severe: slopes of 6 to 20 percent.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Irrigation
Englewood: Mapped only in an association with Wormser soils.	Poor: clay	Unsuited	Poor: high shrink-swell potential.	Slow permeability; slow intake rate.
*Fort Collins: FcA, FcB, FO, FU. For Ascalon soil in FO and Ulm soil in FU, see their respective series.	Fair: clay loam	Unsuited	Fair: moderate shrink-swell potential.	High available water capacity; bedrock at depth of 60 inches or more.
Garrett: Mapped only in association with Maysdorf soils.	Fair: slopes of 6 to 15 percent.	Unsuited	Good	Moderate to high available water capacity; erosion.
*Gateson: GA. For Embry soil in this unit, see Embry series.	Poor: bedrock at depth of 20 to 40 inches; slopes of 10 to 30 percent.	Unsuited	Poor: bedrock at depth of 20 to 40 inches.	[2]
Gaynor: Mapped only in an association with Limon soils and in complexes with Cadoma, Razor, and Samsil soils.	Poor: clay	Unsuited	Poor: high shrink-swell potential.	Moderate salinity; shale at depth of 20 to 40 inches.
*Glenberg: Gd, Ge, GG. For Bankard soil in GG, see the Bankard series.	Good	Unsuited	Good	Moderate to high available water capacity.
Glenberg part of HK	Poor: soluble salts restrict plant growth.	Unsuited	Fair: somewhat poorly drained	Moderate available water capacity.
Gullied land: GU. No interpretations made. Properties too variable.				
Gystrum: Mapped only in complexes with Pokeman and Rekop soils.	Poor: slopes of 10 to 30 percent; bedrock at depth of 20 to 40 inches.	Unsuited	Moderate: moderate shrink-swell potential.	[2]
*Harlan: Ha, HD. For Kirtley soil in HD, see Kirtley series.	Fair: slopes of 3 to 15 percent; clay loam.	Unsuited	Fair: moderate shrink-swell potential.	Slopes of 3 to 15 percent; high available water capacity; moderate permeability.
*Haverson:				
He, Hg, HH, Hm. For Glenberg soil in HH, see Gd under Glenberg series.	Good	Unsuited	Moderate: moderate shrink-swell potential.	High available water capacity; root zone 60 inches deep or more.
Hf, HK. For Glenberg soil in HK, see Glenberg series.	Fair to poor: soluble salts restrict plant growth.	Unsuited	Fair: moderate shrink-swell potential; somewhat poorly drained.	Somewhat poorly drained; soluble salts restrict plant growth.
*Hazton: HN. For Burgess soil in this unit, see Burgess series.	Poor: slopes of 10 to 40 percent; gravelly.	Unsuited	Poor: bedrock at depth of 8 to 20 inches; slopes of 10 to 40 percent.	[1]

See footnotes at end of table.

interpretations of the soils—Continued

Soil features affecting—Continued			Degree and kind of limitation for—		
Drainage for crops and pasture	Pond reservoir areas	Embankments	Dwellings with basements	Septic tank absorption fields	Local roads and streets
Slow permeability; no coarse material in substratum.	Slopes of 6 to 10 percent.	Low shear strength; low permeability when compacted.	Severe: high shrink-swell potential.	Severe: slow permeability.	Severe: high shrink-swell potential.
Moderate permeability.	Moderate permeability; slopes of 0 to 15 percent.	Medium shear strength; low permeability when compacted.	Moderate: moderate shrink-swell potential.	Moderate: moderate permeability; slopes of 0 to 15 percent.	Fair: moderate shrink-swell potential.
Moderate permeability; bedrock at depth of 60 inches or more.	Slopes of 6 to 15 percent; moderate permeability.	Medium shear strength; low permeability when compacted.	Moderate: slopes of 6 to 15 percent.	Moderate: slopes of 6 to 15 percent.	Moderate: slopes of 6 to 15 percent.
(2)	Slopes of 10 to 30 percent; bedrock at depth of 20 to 40 inches.	Medium shear strength; low permeability when compacted.	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Severe: slopes of 10 to 30 percent.
Shale at depth of of 20 to 40 inches; slow permeability.	Slopes of 6 to 20 percent; bedrock at depth of 20 to 40 inches.	Low shear strength; low permeability when compacted.	Severe: shale at depth of 20 to 40 inches; high shrink-swell potential.	Severe: slow permeability; shale at depth of 20 to 40 inches.	Severe: high shrink-swell potential.
Moderately rapid or rapid permeability.	Moderately rapid or rapid permeability.	Medium shear strength; low permeability when compacted.	Severe: occasional flooding; water table at depth of 30 inches to below 60 inches.	Severe: occasional flooding; water table at depth of 30 inches to below 60 inches.	Severe: occasional flooding.
Moderately rapid permeability; occasional flooding.	Moderately rapid permeability.	Medium shear strength.	Severe: occasional flooding.	Severe: occasional flooding.	Severe: occasional flooding.
(2)	Slopes of 10 to 30 percent; bedrock at depth of 20 to 40 inches.	Low shear strength; low permeability when compacted.	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches; slopes of 10 to 30 percent.	Moderate or severe: slopes of 10 to 30 percent.
Shale at depth of 40 to 60 inches in many places.	Slopes of 3 to 15 percent; moderate permeability.	Medium shear strength; low permeability when compacted.	Moderate: slopes of 3 to 15 percent; moderate shrink-swell potential.	Slight to moderate: slopes of 3 to 15 percent.	Moderate: moderate shrink-swell potential.
Moderate or moderately rapid permeability.	Moderate or moderately rapid permeability.	Medium shear strength; low permeability when compacted.	Severe: occasional flooding.	Severe: occasional flooding.	Severe: occasional flooding.
Moderate permeability; occasional flooding.	Moderate permeability.	Medium shear strength; medium piping hazard.	Severe: occasional flooding.	Severe: occasional flooding.	Severe: occasional flooding.
(1)	Slopes of 10 to 40 percent; moderately rapid permeability.	Bedrock at depth of 8 to 20 inches.	Severe: slopes of 10 to 40 percent; bedrock above depth of 20 inches.	Severe: bedrock at depth of 8 to 20 inches; slopes of 10 to 40 percent.	Severe: bedrock at depth of 8 to 20 inches; slopes of 10 to 40 percent.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Irrigation
Heldt: HoA, HoB, HoC	Poor: clay	Unsuited	Poor: high shrink-swell potential.	Slow permeability; slow intake rate.
Indart: IN	Fair to poor: slopes of 10 to 30 percent.	Unsuited	Fair: moderate shrink-swell potential; moderate potential frost action.	(1)
Jenkinson. Mapped only in associations with Turk and Lymanson soils.	Poor: bedrock at depth of 10 to 20 inches.	Unsuited	Poor: bedrock at depth of 10 to 20 inches.	(1)
Julesburg: Ju	Good	Unsuited	Good to fair: slopes of 0 to 20 percent.	Moderately rapid permeability; moderate available water capacity; erodible.
Keyner: KCC	Poor: very strongly alkaline.	Unsuited	Fair: moderate shrink-swell potential.	Moderate available water capacity; very strongly alkaline.
*Kim: KdA, KdB, KdC, KH, KT, KZB, KZD. For Haverson soil in KH, see HH under Haverson series; for Travessilla soil in KT and Zigweid soils in KZB and KZD, see their respective series.	Good to poor: slopes of 0 to 20 percent.	Unsuited	Poor: high plasticity index.	High available water capacity; root zone 60 inches deep; stronger slopes erodible.
Ke	Poor: soluble salts restrict plant growth; slopes of 0 to 20 percent; high salinity.	Unsuited	Poor: high plasticity index.	Soluble salts restrict plant growth; somewhat poorly drained; high available water capacity; high salinity.
Kirtley. Mapped only in associations with Moret and Potts soils.	Fair: clay loam; slopes of 6 to 15 percent.	Unsuited	Poor: high plasticity index.	Shale at depth of 20 to 40 inches; moderate permeability; stronger slopes erodible.
*La Fonda: LA. For Harlan soil in this unit, see Harlan series.	Good to fair: slopes of 3 to 15 percent.	Unsuited	Poor: high plasticity index.	Root zone 60 inches thick; moderate permeability; high available water capacity.
*Leavitt: LE. For Passcreek soil in this unit, see Passcreek series.	Fair to poor: clay loam; slopes of 6 to 20 percent.	Unsuited	Poor: plastic	(1)
*Limon: LmA, LmB, LmC, LnB, LnC, LO, LR. For Cadoma soil in LO and Gaynor soil in LR, see their respective series.	Poor: silty clay	Unsuited	Poor: plastic; high shrink-swell potential.	Slow permeability; root zone 60 inches thick; high salinity in LnB and LnC.

See footnotes at end of table.

interpretations of the soils—Continued

Soil features affecting—Continued			Degree and kind of limitation for—		
Drainage for crops and pasture	Pond reservoir areas	Embankments	Dwellings with basements	Septic tank absorption fields	Local roads and streets
Slow permeability	Slopes of 0 to 10 percent.	Low shear strength; low permeability when compacted.	Severe: high shrink-swell potential.	Severe: slow permeability.	Severe: high shrink-swell potential.
([1])	Slopes of 10 to 30 percent; moderate permeability; bedrock at depth of 20 to 40 inches.	Medium shear strength; low permeability when compacted.	Severe: slopes of 10 to 30 percent; bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches; slopes of 10 to 30 percent.	Moderate to severe: slopes of 10 to 30 percent.
([1])	Slopes of 10 to 30 percent; bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches.	Severe: slopes of 10 to 30 percent; bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches; slopes of 10 to 30 percent.	Severe: hard bedrock at depth of 10 to 20 inches.
Moderately rapid permeability; banks unstable.	Moderately rapid permeability; most slopes exceed 7 percent.	Medium shear strength; low permeability when compacted.	Slight to severe: slopes of 0 to 20 percent.	Slight to severe: slopes of 0 to 20 percent.	Slight to severe: slopes of 0 to 20 percent.
Moderately low permeability.	Slopes of 3 to 15 percent.	Medium shear strength; low permeability when compacted.	Moderate: moderate shrink-swell potential.	Severe: moderately slow permeability; slopes of 3 to 15 percent.	Moderate to severe: slopes of 3 to 15 percent; moderate shrink-swell potential.
Uniform texture to depth of 60 inches; moderate permeability.	Slopes of 0 to 20 percent; moderate permeability.	Medium shear strength; low permeability when compacted.	Moderate to severe: moderate shrink-swell potential; slopes of 0 to 20 percent.	Moderate to severe: slopes of 0 to 20 percent; moderate permeability.	Severe: high plasticity index; slopes of 0 to 20 percent.
Moderate permeability; occasional flooding.	Moderate permeability.	Medium shear strength.	Severe: somewhat poorly drained.	Severe: water table above depth of 48 inches.	Severe: high plasticity index.
Shale bedrock at depth of 20 to 40 inches; moderate permeability.	Bedrock at depth of 20 to 40 inches; slopes of 6 to 15 percent.	Medium shear strength; low permeability when compacted.	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Severe: high plasticity index; slopes of 6 to 15 percent.
Moderate permeability; erodible.	Moderate permeability; slopes of 3 to 15 percent.	Medium shear strength; low permeability when compacted.	Moderate: slopes of 3 to 15 percent; high plasticity index.	Moderate: slopes of 3 to 15 percent; moderate permeability.	Severe: high plasticity index; slopes of 3 to 15 percent.
([1])	Slopes of 6 to 20 percent.	Medium shear strength; low permeability when compacted.	Moderate to severe: slopes of 6 to 20 percent; high plasticity index.	Moderate to severe: slopes of 6 to 20 percent.	Severe: plastic; slopes of 6 to 20 percent.
Slow permeability	Slopes generally more than 7 percent and range from 0 to 20 percent.	Low shear strength; low permeability when compacted.	Severe: high shrink-swell potential.	Severe: slow permeability.	Severe: high shrink-swell potential; plastic.

529-425—75——9

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Irrigation
Lohmiller: Ls	Fair: silty clay loam.	Unsuited [3]	Poor: high shrink-swell potential.	Slow permeability; root zone 60 inches thick.
*Lohsman: LTD For Orella soil in this unit, see Orella series.	Poor: clay	Unsuited	Poor: high shrink-swell potential; plastic.	Shale at depth of 20 to 40 inches; very strongly alkaline.
Lymanson Mapped only in associations with Turk and Jenkinson soils.	Fair to poor: slopes of 10 to 30 percent.	Unsuited	Poor: plastic; slopes of 10 to 30 percent.	[1]
Mathers Mapped only in an association with Pineguest soils.	Poor: gravelly; slopes of 10 to 30 percent.	Poor: high percentage of fines.	Fair: slopes of 10 to 30 percent.	[1]
*Maysdorf: MdB, MdC, MF, MG, MP, MR For Garrett soil in MG, Pugsley soil in MP, and Schooner soil in MR, see their respective series.	Fair: sandy clay loam; slopes of 0 to 15 percent.	Unsuited	Fair: moderate shrink-swell potential.	Root zone to depth of 50 inches or more; stronger slopes erodible; moderate to high available water capacity.
*Moret: MSD, MTD, MU, MV For Rencalson soil in MSD, Kirtley soil in MU, and Shirk soil in MV, see their respective series. For Rock land in MTD, no interpretations made. Properties too variable.	Poor: bedrock at depth of 10 to 20 inches.	Unsuited	Poor: bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches.
*Nathrop: NP, NS, NW For Passcreek soil in NP, Starley soil in NS, and Woosley soil in NW, see their respective series.	Poor: high content of coarse fragments.	Unsuited	Fair: moderate shrink-swell potential.	[1]
Orella Mapped only in complex with Lohsman soils.	Poor: bedrock at depth of 10 to 20 inches.	Unsuited	Poor: high shrink-swell potential.	Bedrock at depth of 10 to 20 inches.
*Otero: OK For Kim soil in this unit, see Kim series.	Fair to poor: slopes of 6 to 20 percent.	Unsuited	Fair: slopes of 6 to 20 percent.	Moderate available water capacity; stronger slopes erodible.
*Passcreek: PA For Slipman and Sublette soils in this unit, see their respective series.	Fair or poor: clay loam; slopes of 6 to 20 percent.	Unsuited	Poor: bedrock at depth of 20 to 40 inches.	[1]
*Petrie: Pc, PE For Bone soil in PE, see Bone series.	Poor: clay	Unsuited	Poor: high shrink-swell potential.	Strongly alkaline; very slow permeability; moderate salinity.

See footnotes at end of table.

interpretations of the soils—Continued

Soil features affecting—Continued			Degree and kind of limitation for—		
Drainage for crops and pasture	Pond reservoir areas	Embankments	Dwellings with basements	Septic tank absorption fields	Local roads and streets
Slow permeability	Low permeability; slopes of 0 to 3 percent.	Low shear strength; low permeability when compacted.	Severe: high-shrink-swell potential; occasional flooding.	Severe: slow permeability; occasional flooding.	Severe: plastic; high shrink-swell potential.
Slow permeability; shale at depth of 20 to 40 inches.	Bedrock at depth of 20 to 40 inches; slopes of 3 to 15 percent.	Low shear strength; low permeability when compacted.	Severe: bedrock at depth of 20 to 40 inches; high shrink-swell potential.	Severe: bedrock at depth of 20 to 40 inches; slow permeability.	Severe: plastic; high shrink-swell potential.
(1)	Slopes of 10 to 30 percent; bedrock at depth of 20 to 40 inches.	Medium shear strength; low permeability when compacted.	Severe: slopes of 10 to 30 percent; bedrock at depth of 20 to 40 inches.	Severe: slopes of 10 to 30 percent; bedrock at depth of 20 to 40 inches.	Severe: plastic; slopes of 10 to 30 percent.
(1)	Slopes of 10 to 30 percent; gravelly.	Medium shear strength; medium permeability when compacted.	Moderate to severe: slopes of 10 to 30 percent.	Moderate to severe: slopes of 10 to 30 percent.	Moderate to severe: slopes of 10 to 30 percent.
Moderate permeability to depth of 32 inches; moderately rapid permeability below that depth.	Moderately rapid permeability below depth of 32 inches; slopes of 0 to 15 percent.	Medium shear strength; low permeability when compacted.	Moderate: moderate shrink-swell potential.	Slight to moderate: slopes of 0 to 15 percent.	Moderate: moderate shrink-swell potential.
Hard shale at depth of 10 to 20 inches.	Slopes of 10 to 30 percent; bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.
(1)	Slopes of 10 to 30 percent; fractured bedrock; high seepage potential.	Medium shear strength; low permeability when compacted.	Moderate to severe: slopes of 10 to 30 percent; moderate shrink-swell	Severe: bedrock at depth of 20 to 40 inches.	Moderate to severe: slopes of 10 to 30 percent.
Shale bedrock at depth of 10 to 20 inches.	Slopes of 6 to 20 percent; bedrock at depth of 10 to 20 inches.	Limited volume of material; bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches; high shrink-swell potential.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.
Moderately rapid permeability.	Moderately rapid permeability; slopes of 6 to 20 percent.	Medium shear strength; medium permeability when compacted.	Moderate to severe: slopes of 6 to 20 percent.	Moderate to severe: slopes of 6 to 20 percent.	Moderate to severe: slopes of 6 to 20 percent.
(1)	Slopes of 6 to 20 percent; bedrock at depth of 20 to 40 inches.	Medium shear strength; low permeability when compacted.	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Moderate to severe: moderate shrink-swell potential; moderate potential frost action; slopes of 6 to 20 percent.
Very slow permeability.	Slopes of 0 to 10 percent.	Low shear strength; low permeability when compacted.	Severe: high shrink-swell potential.	Severe: very slow permeability.	Severe: high shrink-swell potential.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Irrigation
*Pineguest: PG. For Mathers soil in this unit, see Mathers series.	Poor: gravelly coarse sandy loam; slopes of 10 to 30 percent.	Fair to poor: excessive fines.	Fair to poor: moderate potential frost action; slopes of 10 to 30 percent.	(1)
*Pokeman: PKD. For Gystrum and Rekop soils in this unit, see their respective series.	Fair: clay loam	Unsuited	Poor: bedrock at depth of 20 to 40 inches.	(2)
*Poker: PM. For Bachus and Splitro soils in this unit, see their respective series.	Fair to poor: slopes of 6 to 20 percent.	Unsuited	Poor: bedrock at depth of 20 to 40 inches.	(1)
*Potts: PS, PT. For Kim soil in PS and Kirtley soil in PT, see their respective series.	Fair to poor: clay loam; slopes of 6 to 20 percent.	Unsuited	Fair: moderate shrink-swell potential.	Moderate permeability; high available water capacity; slopes of 6 to 20 percent.
*Pugsley: PU, PXD. For Gateson soil in PU and Southfork soil in PXD, see their respective series.	Fair: sandy clay loam; slopes of 6 to 15 percent.	Unsuited	Poor: bedrock at depth of 20 to 40 inches.	Bedrock at depth of 20 to 40 inches; slopes of 6 to 15 percent.
*Razor: RAD. For Gaynor and Samsil soils in this unit, see their respective series.	Poor: silty clay	Unsuited	Poor: bedrock at depth of 20 to 40 inches.	Slow permeability; bedrock at depth of 20 to 40 inches; slopes of 3 to 20 percent.
Redbank. Mapped only in an association with Barnum soils.	Good	Unsuited	Fair: excessive fines.	Root zone 60 inches thick; moderate available water capacity.
Rekop. Mapped only in a complex with Pokeman and Gystrum soils.	Poor: bedrock at depth of 10 to 20 inches.	Unsuited	Poor: bedrock at depth of 10 to 20 inches.	Very limited root zone; bedrock at depth of 10 to 20 inches.
Rencalson. Mapped only in complex with Moret soils.	Fair: clay loam; slopes of 10 to 15 percent.	Unsuited	Poor: bedrock at depth of 20 to 40 inches.	Limited root zone; slow permeability.
*Renohill: RcB, RcC, RD, REC, RED. For Danko soil in RD and Razor soils in REC and RED, see their respective series.	Fair to poor: slopes of 0 to 20 percent; clay loam.	Unsuited	Poor: bedrock at depth of 20 to 40 inches.	Limited root zone; slow permeability in subsoil.
*Rhoame: RhB, RhC, RM, RND. For Moret soil in RND, see Moret series.	Poor: high content of coarse fragments.	Unsuited	Moderate: moderate shrink-swell potential.	Root zone 60 inches thick; slow permeability; stronger slopes erodible.

See footnotes at end of table.

interpretations of the soils—Continued

Soil features affecting—Continued			Degree and kind of limitation for—		
Drainage for crops and pasture	Pond reservoir areas	Embankments	Dwellings with basements	Septic tank absorption fields	Local roads and streets
(1)	Moderately rapid permeability; slopes of 10 to 30 percent.	Medium shear strength; medium permeability when compacted.	Moderate to severe: moderate potential frost action; slopes of 10 to 30 percent.	Moderate to severe: slopes of 10 to 30 percent.	Moderate to severe: moderate potential frost action; slopes of 10 to 30 percent.
(2)	Slopes of 6 to 15 percent; bedrock at depth of 20 to 40 inches; moderate permeability.	Low shear strength; low permeability; when compacted.	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Moderate: moderate shrink-swell potential; bedrock at depth of 20 to 40 inches.
(1)	Bedrock at depth of 20 to 40 inches; slopes of 6 to 20 percent; moderately rapid permeability.	Medium shear strength; low permeability when compacted.	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Moderate to severe: bedrock at depth of 20 to 40 inches; slopes of 6 to 20 percent.
Moderate permeability.	Moderate permeability; slopes of 6 to 20 percent.	Medium shear strength; low permeability when compacted; medium piping hazard.	Moderate to severe: moderate shrink-swell potential; slopes of 6 to 20 percent.	Moderate to severe: moderate permeability; slopes of 6 to 20 percent.	Moderate or severe: moderate shrink-swell potential; slopes of 6 to 20 percent.
Bedrock at depth of 20 to 40 inches.	Moderately rapid permeability; bedrock at depth of 20 to 40 inches; slopes of 6 to 15 percent.	Medium shear strength; low permeability when compacted.	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Moderate: bedrock at depth of 20 to 40 inches; moderate shrink-swell potential.
Bedrock at depth of 20 to 40 inches.	Bedrock at depth of 20 to 40 inches; slopes of 3 to 20 percent.	Low shear strength; low permeability when compacted.	Severe: high shrink-swell potential.	Severe: bedrock at depth of 20 to 40 inches.	Severe: high shrink-swell potential.
Moderately rapid permeability.	Moderately rapid permeability.	Fair to good compaction characteristics; low permeability when compacted; medium shear strength.	Severe: occasional flooding.	Severe: occasional flooding.	Severe: excessive fines; occasional flooding.
Bedrock at depth of 10 to 20 inches.	Slopes of 10 to 30 percent; bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.
Shale at depth of 20 to 40 inches; slow permeability.	Bedrock at depth of 20 to 40 inches; slopes of 10 to 15 percent.	Medium shear strength; low permeability when compacted.	Severe: high shrink-swell potential.	Severe: bedrock at depth of 20 to 40 inches; slow permeability.	Sever: high shrink-swllpotential.
Shale bedrock at depth of 20 to 40 inches.	Bedrock at depth of 20 to 40 inches.	Medium shear strength; low permeability when compacted.	Severe: high shrink-swell potential.	Severe: slow permeability; bedrock at depth of 20 to 40 inches.	Severe: high shrink-swell potential.
Slow permeability	Slopes of 0 to 20 percent.	Fair to poor compaction characteristics; low shear strength; low permeability when compacted.	Moderate to severe: moderate shrink-swell potential; slopes of 0 to 20 percent.	Severe: slow permeability.	Moderate to severe: moderate shrink-swell potential; slopes of 0 to 20 percent.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of— Topsoil	Sand and gravel	Road fill	Soil features affecting— Irrigation
Rock land: RO. No interpretations made. Properties too variable.				
Rock outcrop. No interpretations made. Properties too variable. Mapped only with other soils.				
Saline, wet land: SA. No interpretations made. Properties too variable.				
*Samsil: SCD, SDE, SE. For Gaynor and Cadoma soils in SCD and Renohill soil in SE, see their respective series; for Shale outcrop in SDE, no interpretations made. Properties too variable.	Poor: silty clay; bedrock at depth of 8 to 20 inches.	Unsuited	Poor: bedrock at depth of 8 to 20 inches.	Bedrock at depth of 8 to 20 inches; very limited root zone; slopes of 6 to 40 percent.
*Sanford: SF. For Wetterhorn soil in this unit, see Wetterhorn series.	Fair to poor: slopes of 6 to 20 percent.	Poor: excessive fines.	Poor: bedrock at depth of 20 to 40 inches.	(1)
Sawcreek. Mapped only in an association with Tripit soils.	Fair to poor: slopes of 6 to 20 percent.	Poor: excessive fines.	Poor: bedrock at depth of 20 to 40 inches.	(1)
Schooner. Mapped only in an association with Maysdorf soils.	Poor: sand; bedrock at depth of 10 to 20 inches.	Poor: bedrock at depth of 10 to 20 inches.	Poor: bedrock at depth of 10 to 20 inches.	(2)
Shale outcrop: SH. No interpretations made. Properties too variable.				
Shale rock land: SK. No interpretations made. Properties too variable.				
*Shingle: Sm, SNa, SNb, SNc, SNd, SNe, SNf. For Briggsdale soil in SNa, Cushman soil in SNb, Kim soils in SNc and SNd, Tassel soil in SNe, and Worf soil in SNf, see their respective series.	Poor: bedrock at depth of 8 to 20 inches.	Unsuited	Poor: bedrock at depth of 8 to 20 inches.	Bedrock at depth of 8 to 20 inches; very limited root zone; slopes of 3 to 40 percent.
Shirk. Mapped only in associations with Moret and Wormser soils.	Fair to poor: slopes of 10 to 20 percent.	Unsuited	Poor: bedrock at depth of 20 to 40 inches.	Limited root zone; moderate permeability; bedrock at depth of 20 to 40 inches.
*Simmont: SOE. For Rock outcrop in this unit, no interpretations made. Properties too variable.	Poor: slopes of 15 to 40 percent; high content of coarse fragments.	Unsuited	Poor: bedrock at depth of 20 to 40 inches.	(2)
Slipman. Mapped only in associations with Passcreek and Sublette soils.	Fair to poor: slopes of 10 to 20 percent.	Poor: excessive fines.	Fair: moderate shrink-swell potential.	(1)

See footnotes at end of table.

interpretations of the soils—Continued

Soil features affecting—Continued			Degree and kind of limitation for—		
Drainage for crops and pasture	Pond reservoir areas	Embankments	Dwellings with basements	Septic tank absorption fields	Local roads and streets
Bedrock at depth of 8 to 20 inches.	Bedrock at depth of 8 to 20 inches.	Bedrock at depth of 8 to 20 inches.	Severe: bedrock at depth of 8 to 20 inches.	Severe: bedrock at depth of 8 to 20 inches.	Severe: bedrock at depth of 8 to 20 inches.
(1)	Slopes of 6 to 20 percent; bedrock at depth of 20 to 40 inches; moderately rapid permeability.	Medium shear strength; low permeability when compacted.	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Moderate tosevere: slopes of 6 to 20 percent.
(1)	Slopes of 6 to 20 percent; bedrock at depth of 20 to 40 inches.	Medium shear strength; low permeability when compacted.	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches; slopes of 6 to 20 percent.	Moderate to severe: slopes of 6 to 20 percent.
(2)	Bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.
Bedrock at depth of 8 to 20 inches.	Bedrock at depth of 8 to 20 inches.	Bedrock at depth of 8 to 20 inches.	Severe: bedrock at depth of 8 to 20 inches.	Severe: bedrock at depth of 8 to 20 inches.	Severe: bedrock at depth of 8 to 20 inches.
Shale bedrock at depth of 20 to 40 inches.	Slopes of 10 to 20 percent.	Medium shear strength; low permeability when compacted.	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Severe: high plasticity index.
(2)	Slopes of 15 to 40 percent; bedrock at depth of 20 to 40 inches.	Bedrock at depth of 20 to 40 inches; many cobblestones.	Severe: slopes of 15 to 40 percent.	Severe: bedrock at depth of 20 to 40 inches; slopes of 15 to 40 percent.	Severe: slopes of 15 to 40 percent.
(1)	Slopes of 10 to 20 percent.	Medium shear strength; low permeability when compacted.	Moderate to severe: slopes of 10 to 20 percent; moderate shrink-swell potential.	Moderate to severe: slopes of 10 to 20 percent.	Moderate to severe: slopes of 10 to 20 percent.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Irrigation
Slocum. Mapped only in association with Auzqui soils.	Fair: clay loam	Unsuited	Poor: high potential frost action.	(1)
Southfork. Mapped only in complex with Pugsley soils.	Poor: bedrock at depth of 10 to 20 inches.	Unsuited	Poor: bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches; very limited root zone; slopes of 10 to 30 percent.
*Spearfish: SPE. For Shale outcrop in this unit, no interpretations made. Properties too variable.	Poor: bedrock at depth of 8 to 20 inches.	Unsuited	Poor: bedrock at depth of 8 to 20 inches.	Bedrock at depth of 8 to 20 inches; very limited root zone; slopes of 10 to 40 percent; highly erodible.
Splitro. Mapped only in associations with Poker and Bachus soils.	Poor: bedrock at depth of 10 to 20 inches.	Unsuited	Poor: bedrock at depth of 10 to 20 inches.	(1)
*Starley: SRE. For Rock outcrop in this unit, no interpretations made. Properties too variable.	Poor: high content of coarse fragments; bedrock at depth of 8 to 20 inches.	Unsuited	Poor: bedrock at depth of 8 to 20 inches.	(1)
*Stoneham: SsA, SsB, SsC, STa, STb, STc, STd, STe, STf, STg. For Absted soil in STa, Ascalon soil in STb, Cragola soil in STc, Cushman soil in STd, Fort Collins soil in STe, Kim soil in STf, and Zigweid soil in STg, see their respective series.	Fair where slopes are 0 to 15 percent; clay loam. Poor where slopes are 15 to 20 percent.	Unsuited	Poor: high plasticity index.	High available water capacity; steeper slopes are erodible.
*Stubbs: SU. For Turk soil in this unit, see Turk series.	Fair to poor: slopes of 6 to 20 percent; clay loam.	Unsuited	Poor: bedrock at depth of 20 to 40 inches.	(1)
Sublette. Mapped only in associations with Passcreek and Slipman soils.	Fair to poor: content of coarse fragments about 10 to 20 percent.	Unsuited	Fair: moderate potential frost action.	(1)
*Sunup: SVE, SW. For Carnero soil in SW, see Carnero series. For Rock outcrop in SVE, no interpretations made. Properties too variable.	Poor: bedrock at depth of 10 to 20 inches.	Unsuited	Poor: bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches; very limited root zone; slopes of 15 to 40 percent.
Tassel. Mapped only in an association with Terry soils.	Poor: bedrock at depth of 8 to 20 inches.	Unsuited	Poor: bedrock at depth of 8 to 20 inches.	Bedrock at depth of 8 to 20 inches; very limited root zone; slopes of 15 to 40 percent.
*Terry: TE. For Tassel soil in this unit, see Tassel series.	Fair: slopes of 6 to 15 percent.	Unsuited	Poor: bedrock at depth of 20 to 40 inches.	Bedrock at depth of 20 to 40 inches; moderately rapid permeability.

See footnotes at end of table.

interpretations of the soils—Continued

Soil features affecting—Continued			Degree and kind of limitation for—		
Drainage for crops and pasture	Pond reservoir areas	Embankments	Dwellings with basements	Septic tank absorption fields	Local roads and streets
(1)	Slopes of 3 to 10 percent.	Medium to low shear strength; fair to good compaction characteristics.	Severe: high shrink-swell potential; high potential frost action.	Severe: seasonal high water table at depth of 24 to 36 inches.	Severe: high shrink-swell potential; high potential frost action.
Bedrock at depth of 10 to 20 inches.	Slopes of 10 to 30 percent; bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.
Bedrock at depth of 8 to 20 inches.	Slopes of 8 to 20 percent; bedrock at depth of 8 to 20 inches.	Bedrock at depth of 8 to 20 inches.	Severe: bedrock at depth of 8 to 20 inches.	Severe: bedrock at depth of 8 to 20 inches.	Severe: bedrock at depth of 8 to 20 inches.
(1)	Slopes of 6 to 30 percent; bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.
(1)	Slopes of 10 to 40 percent; bedrock at depth of 8 to 20 inches.	Bedrock at depth of 8 to 20 inches.	Severe: bedrock at depth of 8 to 20 inches.	Severe: bedrock at depth of 8 to 20 inches.	Severe: bedrock at depth of 8 to 20 inches.
Moderate permeability to depth of 60 inches.	Moderate permeability; slopes of 0 to 20 percent.	Medium shear strength; fair to good compaction characteristics; low permeability when compacted.	Moderate to severe: moderate shrink-swell potential; slopes of 0 to 20 percent.	Moderate where slopes are 0 to 15 percent; moderate permeability. Severe where slopes are 15 to 20 percent.	Severe: high plasticity index.
(1)	Slopes of 6 to 20 percent; bedrock at depth of 20 to 40 inches.	Low shear strength; fair to poor compaction characteristics.	Moderate to severe: moderate shrink-swell potential; slopes of 6 to 20 percent.	Severe: bedrock at depth of 20 to 40 inches.	Severe: high plasticity index.
(1)	Slopes of 6 to 20 percent; rapid permeability.	Fair to poor compaction characteristics; medium shear strength; low permeability when compacted.	Moderate to severe: slopes of 6 to 20 percent.	Moderate to severe: slopes of 6 to 20 percent.	Moderate to severe: slopes of 6 to 20 percent.
Hard bedrock at depth of 10 to 20 inches.	Slopes of 15 to 40 percent; bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches.	Severe: slopes of 15 to 40 percent; bedrock at depth of 10 to 20 inches.	Severe: slopes of 15 to 40 percent; bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.
Bedrock at depth of 8 to 20 inches.	Slopes of 15 to 40 percent; bedrock at depth of 8 to 20 inches.	Bedrock at depth of 8 to 20 inches.	Severe: slopes of 15 to 40 percent; bedrock at depth of 8 to 20 inches.	Severe: slopes of 15 to 40 percent; bedrock at depth of 8 to 20 inches.	Severe: slopes of 15 to 40 percent; bedrock at depth of 8 to 20 inches.
Moderately rapid permeability; sandstone bedrock at depth of 20 to 40 inches.	Slopes of 6 to 15 percent; bedrock at depth of 20 to 40 inches.	Medium shear strength; low permeability when compacted.	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Moderate: slopes of 6 to 15 percent; bedrock at depth of 20 to 40 inches.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Irrigation
Tolman. Mapped only in an association with Bayerton soils.	Poor: excessive amount of coarse fragments; bedrock at depth of 10 to 20 inches.	Unsuited	Poor: bedrock at depth of 10 to 20 inches.	(1)
*Travessilla: TRE. For Rock outcrop in this unit, no interpretations made. Properties too variable.	Poor: bedrock at depth of 10 to 20 inches.	Unsuited	Poor: bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches; very limited root zone; slopes of 15 to 40 percent.
*Tripit: TS, TT. For Devoe soil in TS and Sawcreek soil in TT, see their respective series.	Fair to poor: slopes of 6 to 20 percent; clay loam.	Unsuited	Poor: bedrock at depth of 20 to 40 inches.	(1)
*Turk: TU. For Lymanson and Jenkinson soils in this unit, see their respective series.	Poor: clay	Unsuited	Poor: bedrock at depth of 20 to 40 inches; high shrink-swell potential.	(1)
*Ulm: UlA, UlB, UM, UW. For Cushman soil in UM and Wyarno soil in UW, see their respective series.	Fair: clay loam	Unsuited	Poor: high shrink-swell potential.	Root zone 60 inches deep; moderate permeability; high available water capacity.
*Valent: VC. For Cushman soil in this unit, see Cushman series.	Poor: sand	Poor: excessive amount of fines.	Good to fair: slopes of 6 to 20 percent.	Low availaple water capacity; root zone 60 inches deep; erodible.
Wetterhorn. Mapped only in an association with Sanford soils.	Fair to poor: slopes of 6 to 20 percent; clay loam.	Unsuited	Poor: bedrock at depth of 20 to 40 inches.	(1)
*Wolf: WC. For Cragola soil in this unit, see Cragola series.	Fair: clay loam	Unsuited [4]	Poor: igh plasticity index.	High available water capacity; steeper slopes erodible.
Woosley. Mapped only in an association with Decross soils.	Fair to poor: clay loams; slopes of 6 to 20 percent.	Unsuited	Poor: bedrock at depth of 20 to 40 inches.	(1)
Worf. Mapped only in associations with Briggsdale and Shingle soils.	Poor: bedrock at depth of 10 to 20 inches.	Unsuited	Poor: bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches; very limited root zone; slopes of 6 to 30 percent.
*Worsmer: WE, WM. For Englewood soil in WE and Shirk soil in WM, see their respective series.	Fair: clay loam; slopes of 6 to 15 percent.	Unsuited	Poor: bedrock at depth of 20 to 40 inches.	Bedrock at depth of 20 to 40 inches; limited root zone; steeper slopes erodible.

See footnotes at end of table.

interpretations of the soils—Continued

Soil features affecting—Continued			Degree and kind of limitation for—		
Drainage or crops and pasture	Pond reservoir areas	Embankments	Dwellings with basements	Septic tank absorption fields	Local roads and streets
(1)	Slopes of 10 to 40 percent; bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.
Hard bedrock at depth of 10 to 20 inches.	Slopes of 15 to 40 percent; bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches.	Severe: slopes of 15 to 40 percent; bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches; slopes of 15 to 40 percent.	Severe: bedrock at depth of 10 to 20 inches; slopes of 15 to 40 percent.
(1)	Slopes of 6 to 20 percent; bedrock at depth of 20 to 40 inches.	Bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Severe: slopes of 6 to 20 percent; high content of fines.
(1)	Slopes of 6 to 20 percent; bedrock at depth of 20 to 40 inches.	Fair to poor compaction characteristics; low shear strength.	Severe: high shrink-swell potential.	Severe: bedrock at depth of 20 to 40 inches; slow permeability.	Severe: high shrink-swell potential.
Moderate permeability; no coarse material in substratum.	Moderate permeability; slopes of 0 to 10 percent.	Fair to good compaction characteristics; medium shear strength; low permeability when compacted.	Severe: high potential frost action.	Moderate: moderate permeability; slopes of 0 to 10 percent.	Severe: high shrink-swell potential.
Rapid permeability.	Slopes of 6 to 20 percent; rapid permeability.	Medium shear strength; low permeability when compacted.	Moderate where slopes are 6 to 15 percent. Severe where slopes are 15 to 20 percent.	Moderate where slopes are 6 to 15 percent. Severe where slopes are 15 to 20 percent.	Moderate to severe: slopes of 6 to 20 percent.
(1)	Slopes of 6 to 20 percent; bedrock at depth of 20 to 40 inches.	Medium shear strength; low permeability when compacted.	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Severe: high plasticity index.
Moderate permeability; gravelly substratum.	Slopes of 0 to 15 percent; moderate permeability.	Fair to good compaction characteristics; medium shear strength; low permeability when compacted.	Moderate: moderate shrink-swell potential.	Moderate: moderate permeability.	Severe: high plasticity index.
(1)	Slopes of 6 to 20 percent; bedrock at depth of 20 to 40 inches.	Medium shear strength; low permeability when compacted.	Severe: bedrock at depth of 20 to 40 inches.	Severe: bedrock at depth of 20 to 40 inches.	Severe: high plasticity index.
Bedrock at depth of 10 to 20 inches.	Slopes of 6 to 30 percent; bedrock at depth of 10 to 20 inches.	Bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.	Severe: bedrock at depth of 10 to 20 inches.
Shale bedrock at depth of 20 to 40 inches.	Slopes of 6 to 15 percent; bedrock at depth of 20 to 40 inches.	Medium shear strength; fair to good compaction characteristics.	Severe: high shrink-swell potential.	Severe: bedrock at depth of 20 to 40 inches.	Severe: high shrink-swell potential.

TABLE 5.—*Engineering*

Soil series and map symbols	Suitability as source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Irrigation
*Wyarno: WnA, WnB, WO, WY For Limon soil in WO and Stoneham soil in WY, see their respective series.	Poor: clay loam or clay.	Unsuited	Poor: high shrink-swell potential.	Moderately slow permeability; high available water capacity; root zone 60 inches deep.
*Zigweid: ZgA, ZgB, ZKD For Keyner soil in ZKD, see Keyner series.	Fair to poor: slopes of 0 to 20 percent.	Unsuited	Poor: high plasticity index.	Root zone 60 inches deep; steep slopes erodible; high available water capacity.

[1] Not applicable because the soils occur in the mountainous areas that have a frost-free season of 60 to 75 days.
[2] Not applicable because the soils occur on the mountain flanks or on the steep pine ridges.

TABLE 6.—*Engineering*

[Tests performed by the Wyoming Department of Highways, Materials Testing Laboratory, Cheyenne, Wyoming, in

Soil name and location	Parent material	Wyoming report No.	Depth	Moisture-density [1]	
				Maximum dry density	Optimum moisture
			In.	*Pct.*	*Pct.*
Amsden loam: SE¼NW¼ sec. 12, T. 46 N., R. 85 W. (Modal)	Reddish sediments wasted from red shale and siltstone.	67–1900	3–10	92	24
		67–1901	14–22	103	19
		67–1902	29–43	96	24
Decross loam: 100 feet north of gate in right-of-way fence, 50 feet west, NW¼ SE¼ sec. 22, T. 46 N., R. 85 W. (Modal)	Loamy alluvium washed from wasted limestone.	67–1903	5–12	87	30
		67–1904	12–18	102	20
		67–1905	25–40	119	13
Dell silt loam: SW¼SW¼ sec. 23, T. 45 N., R. 85 W. (Modal)	Residual or locally washed materials from limestone.	67–1909	8–13	95	25
		67–1910	20–33	108	19
Mathers loam: SW¼SW¼ sec. 24, T. 47 N., R. 85 W. (Modal)	Mixed gravelly, loamy, and sandy till and outwash from granitic sources.	67–1897	6–9	122	10
		67–1898	12–20	121	11
		67–1899	39–49	124	11
Turk silty clay loam: NE¼NE¼ sec. 28, T. 45 N., R. 85 W. (Modal)	Fine-textured materials from clay shale.	67–1906	7–12	92	27
		67–1907	18–32	100	22
		67–1908	41–47	112	18

[1] Based on AASHO Designation T 99–57, Method A (*1*).
[2] Mechanical analyses according to the AASHO Designation T 88–57 (*1*). Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method

interpretations of the soils—Continued

Soil features affecting—Continued			Degree and kind of limitation for		
Drainage for crops and pasture	Pond reservoir areas	Embankments	Dwellings with basements	Septic tank absorption fields	Local roads and streets
Moderately slow permeability; no coarse material in substratum.	Slopes of 0 to 15 percent.	Fair to poor compaction characteristics; low shear strength.	Severe: high shrink-swell potential.	Severe: moderately low permeability.	Severe: high shrink-swell potential.
Moderate permeability.	Slopes of 0 to 20 percent; moderate permeability.	Medium to low shear strength; low permeability when compacted.	Moderate to severe: slopes of 0 to 20 percent; moderate shrink-swell potential.	Moderate to severe: moderate permeability; slopes of 0 to 20 percent.	Severe: slopes of 0 to 20 percent; high plasticity index.

[3] Coarse sandy material occurs at a depth of more than 40 inches in some places.
[4] Terrace gravel occurs at a depth of more than 5 feet.

test data

accordance with standard procedures of the American Association of State Highway Officials (AASHO)]

Mechanical analysis [2]					Liquid limit	Plasticity index	Classification	
Percentage passing sieve—				Percentage smaller than—			AASHO [3]	Unified [4]
No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	0.005 mm.				
97	96	95	80	39	51	18	A-7-5(13)	MH
99	98	97	83	40	46	19	A-7-6(13)	CL
98	94	91	71	40	49	19	A-7-5(14)	ML
100	100	99	87	30	49	16	A-7-5(12)	ML
100	100	100	98	41	43	14	A-7-6(11)	ML
65	64	62	53	22	33	9	A-4(3)	ML
100	99	98	90	48	49	25	A-7-6(16)	CL
100	89	87	75	30	34	12	A-6(9)	CL
97	91	59	43	15	23	2	A-4(1)	SM
82	74	39	18	13	31	5	A-1-6(0)	SM
83	73	30	12	8	30	([5])	A-1-b(0)	SM
100	99	97	89	53	62	31	A-7-5(20)	CH
100	99	97	85	52	51	28	A-7-6(17)	CH
100	98	91	80	38	48	26	A-7-6(16)	CL

and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soils.
[3] Based on AASHO Designation M 145-49 (*1*).
[4] Based on MIL-STD-619B (*9*).
[5] Nonplastic.

529-425—75——10

Depth to seasonal high water table is not shown in table 4 because it is significant for only a few soils in the survey area.

Depth to bedrock is distance from the surface of the soil to the upper surface of the rock layer.

Soil texture is described in table 4 in the standard terms used by the Department of Agriculture. These terms take into account relative percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. Loam, for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, gravelly loamy sand. Sand, silt, clay, and some of the other terms used in USDA textural classification are defined in the Glossary.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil material. As the moisture content of a clayey soil is increased from a dry state, the material changes from a semisolid to a plastic. If the moisture content is further increased, the material changes from a plastic to a liquid. The plastic limit is the moisture content at which the soil material changes from a semisolid to a plastic; and the liquid limit, from a plastic to a liquid. The plasticity index is the numerical difference between the liquid limit and the plastic limit. It indicates the range of mositure content within which a soil material is plastic. Liquid limit and plasticity index are estimated in table 4, but in table 6 the data on liquid limit and plasticity index are based on tests of soil samples.

Permeability is that quality of a soil that enables it to transmit water or air. It is estimated on the basis of those soil characteristics that are observed in the field, particularly structure and texture. The estimates in table 4 do not take into account lateral seepage or such transient soil features as plowpans and surface crusts.

Available water capacity is the ability of soils to hold water for use by most plants. It is commonly defined as the difference between the amount of water in the soil at field capacity and the amount at the wilting point of most crops.

Reaction is the degree of acidity or alkalinity of a soil, expressed as a pH value. The pH value and terms used to describe soil reaction are explained in the Glossary.

Salinity refers to the amount of soluble salts in the soil. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25° C. Salinity affects the suitability of a soil for crops, its stability when used as construction material, and its corrosiveness to metals and concrete.

Shrink-swell potential is the relative change in volume to be expected of soil material with changes in moisture content, that is, the extent to which the soil shrinks as it dries out or swells as it gets wet. Extent of shrinking and swelling is influenced by the amount and kind of clay in the soil. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A *high* shrink-swell potential indicates a hazard to maintenance of structures built in, on, or with material that has this rating.

Engineering interpretations of soils

The estimated interpretations in table 5 are based on the engineering properties of soils shown in table 4, on test data for soils in this survey area and others nearby or adjoining, and on the experience of engineers and soil scientists with the soils of Johnson County, Southern Part. In table 5, ratings are used to summarize limitation or suitability of the soils for all listed purposes other than for drainage of cropland and pasture, irrigation, ponds and reservoirs, embankments, and terraces and diversions. For these particular uses, table 5 lists those soil features not to be overlooked in planning, installation, and maintenance.

Soil limitations are indicated by the ratings of slight, moderate, and severe. *Slight* means soil properties generally are favorable for the rated use or, in other words, limitations are minor and easily overcome. *Moderate* means that some soil properties are unfavorable but can be overcome or modified by special planning and design. *Severe* means soil properties are so unfavorable and so difficult to correct or overcome that they require major soil reclamation and special designs.

Soil suitability is rated by the terms *good*, *fair*, and *poor*, which have meanings approximately parallel to the terms slight, moderate, and severe.

Following are explanations of some of the columns in table 5.

Topsoil is used for topdressing an area where vegetation is to be established and maintained. Suitability is affected mainly by ease of working and spreading the soil material, as in preparing a seedbed; natural fertility of the material, or the response of plants grown on it if fertilizer is applied; and absence of substances toxic to plants. Texture of the soil material and its content of stone fragments are characteristics that affect suitability, but also considered in the ratings is damage that results at the area from which topsoil is taken.

Sand and gravel are used in great quantities in many kinds of construction. The ratings in table 5 provide guidance about where to look for probable sources. A soil rated as a *good* or *fair* source of sand or gravel generally has a layer at least 3 feet thick, the top of which is within a depth of 6 feet. The ratings do not take into account thickness of overburden, location of the water table, or other factors that affect mining of the materials, and they do not indicate quality of the deposit.

Road fill is soil material used in embankments for roads. The suitability ratings reflect (1) the predicted performance of soil after it has been placed in an embankment that has been properly compacted and provided with adequate drainage and (2) the relative ease of excavating the material at borrow areas.

Irrigation of a soil is affected by such features as slope; susceptibility to stream overflow, water erosion, or wind erosion; soil texture; content of stones; accumulations of salts and alkali; depth of root zone; rate of water intake at the surface; permeability of soil layers below the surface layer and in the fragipan or other layers that restrict movement of water; amount of water held available to plants; and need for drainage, or depth to water table or bedrock.

Drainage of cropland and pasture is affected by such soil properties as permeability, texture, and structure; depth to claypan, rock, or other layers that influence rate

of water movement; depth to the water table; slope; stability in ditchbanks; susceptibility to stream overflow; salinity or alkalinity; and availability of outlets for drainage.

Pond reservoir areas hold water behind a dam or embankment. Soils suitable for pond reservoir areas have low seepage, which is related to their permeability and depth to fractured or permeable bedrock or other permeable material.

Embankments require soil material that is resistant to seepage and piping and that has favorable stability, shrink-swell potential, shear strength, and compactibility. Stones or organic material in a soil are among the factors that are unfavorable.

Dwellings, as rated in table 5, are no more than three stories high and are supported by foundation footings placed in undisturbed soil. The features that affect the rating of a soil for dwellings are those that relate to its capacity to support load and to resist settlement under load, and those that relate to ease of excavation. Soil properties that affect capacity to support load are wetness, susceptibility to flooding, density, plasticity, texture, and shrink-swell potential. Those that affect excavation are wetness, slope, depth to bedrock, and content of stones and rocks.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into natural soil. The soil material between depths of 18 inches and 6 feet is evaluated. The soil properties considered are those that affect both absorption of effluent and construction and operation of the system. Properties that affect absorption are permeability, depth to water table or rock, and susceptibility to flooding. Slope is a soil property that affects difficulty of layout and construction and also the risk of soil erosion, lateral seepage, and downslope flow of effluent. Large rocks or boulders increase construction costs.

Local roads and streets, as rated in table 5, have an all-weather surface expected to carry automobile traffic all year. They have a subgrade of underlying soil material; a base of gravel, crushed rock, or soil material that is stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. These roads are graded to shed water and have ordinary provisions for drainage. They are built mainly from soil at hand, and most cuts and fills are less than 6 feet deep.

Soil properties that most affect design and construction of roads and streets are load-supporting capacity and stability of the subgrade, and the workability and quantity of cut and fill material available. The AASHO and Unified classifications of the soil material and, also, the shrink-swell potential indicate its traffic-supporting capacity. Wetness and flooding affect stability of the material. Slope, depth to hard rock, content of stones and rocks, and wetness affect ease of excavation and amount of cut and fill needed to reach an even grade.

Engineering test data

Table 6 contains engineering test data for some of the major soil series in Johnson County, Southern Part. These tests were made to help evaluate the soils for engineering purposes. The engineering classifications shown are based on data obtained by mechanical analyses and by tests to determine liquid limit and plastic limit. The mechanical analyses were made by combined sieve and hydrometer methods.

Compaction, or moisture-density, data are important in earthwork. If a soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material increases until the *optimum moisture content* is reached. After that, density decreases with increase in moisture content. The highest dry density obtained in the compactive test is termed *maximum dry density*. As a rule, maximum strength of earthwork is obtained if the soil is compacted to the maximum dry density.

Formation and Classification of the Soils

This section describes how the factors of soil formation affected the soils in Johnson County, Southern Part, explains the current system of soil classification, and shows the results of laboratory analyses. Table 7 shows the classification of each soil series by higher categories, according to the current system. Table 8 shows physical and chemical data for selected soils in the survey area.

Factors of Soil Formation

Soil is formed by the action of soil-forming processes on accumulated or deposited geologic material. The five important soil-forming factors are relief, parent material, climate, living organisms, and time. The characteristics of the soil at any given location are determined by these five factors. They control the kind of soil-forming processes and the rate at which they progress. All of the factors are active in the formation of every soil, but one factor may be dominant.

Relief

Relief, or lay of the land, influences the formation of soils through its effect on runoff, drainage, and exposure. Sloping or moderately steep soils on uplands, such as Shingle soils, form on ridges and have a thin profile because much of the precipitation runs off. As the slope decreases below the ridges, such soils as those of the Cushman and Briggsdale series take in more moisture, and they have thicker profiles than Shingle soils. The Fort Collins and Ulm soils formed on alluvial fans, and they take in most of the moisture that falls on them. This is reflected in the depth to which soil-forming processes have altered the parent material.

Relief is an important soil-forming factor along stream channels. Low-lying soils in many places are flooded periodically. Some soils have a fluctuating water table and are poorly drained. Soils that form in valleys generally receive additional moisture as runoff from adjacent slopes. This has occurred on Ascalon soils in some areas, and as a result they have a thicker, darker colored surface layer and subsoil than soils in other areas. Ascalon soils also receive additional moisture from snowdrifts.

In some areas, particularly in the mountains, exposure affects soil formation. The north- and east-facing mountain slopes retain the over-winter snowpack longer than

TABLE 7.—*Classification of soil series by higher categories*

Series	Family	Subgroup	Order
Absted	Fine, montmorillonitic, mesic	Haplustollic Natrargids	Aridisols.
Amsden	Fine-loamy, mixed	Argic Cryoborolls	Mollisols.
Ascalon	Fine-loamy, mixed, mesic	Aridic Argiustolls	Mollisols.
Auzqui	Fine-loamy, mixed	Typic Cryoborolls	Mollisols.
Bachus	Fine-loamy, mixed	Argic Pachic Cryoborolls	Mollisols.
Bankard	Sandy, mixed, mesic	Ustic Torrifluvents	Entisols.
Barnum	Fine-loamy, mixed, calcareous, mesic	Ustic Torrifluvents	Entisols.
Barnum, sandy subsoil variant	Fine-loamy over sandy or sandy-skeletal, mixed, calcareous, mesic.	Ustic Torrifluvents	Entisols.
Bayerton	Fine-loamy, mixed	Typic Eutroboralfs	Alfisols.
Bidman	Fine, montmorillonitic, mesic	Ustollic Paleargids	Aridisols.
Big Horn	Fine, montmorillonitic, mesic	Ustollic Paleargids	Aridisols.
Bone	Fine, montmorillonitic, calcareous, mesic	Ustic Torriorthents	Entisols.
Briggsdale	Fine, montmorillonitic, mesic	Ustollic Paleargids	Aridisols.
Burgess	Coarse-loamy, mixed	Argic Cryoborolls	Mollisols.
Cadoma	Fine, montmorillonitic, mesic	Ustollic Camborthids	Aridisols.
Carnero	Fine-loamy, mixed, mesic	Aridic Argiustolls	Mollisols.
Cloud Peak	Loamy-skeletal, mixed	Typic Cryoboralfs	Alfisols.
Connerton	Fine-loamy, mixed, mesic	Torriorthentic Haplustolls	Mollisols.
Cragola	Loamy-skeletal, mixed, calcareous, mesic, shallow.	Ustic Torriorthents	Entisols.
Cushman	Fine-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Danko	Clayey, montmorillonitic, calcareous, mesic, shallow.	Ustic Torriorthents	Entisols.
Decross	Fine-loamy, mixed	Argic Pachic Cryoborolls	Mollisols.
Dell	Fine, montmorillonitic	Typic Cryoboralfs	Alfisols.
Devoe	Loamy, mixed, shallow	Typic Cryoborolls	Mollisols.
Embry	Coarse-loamy, mixed, nonacid, mesic	Ustic Torriorthents	Entisols.
Englewood	Fine, montmorillonitic, mesic	Torrertic Argiustolls	Mollisols.
Fort Collins	Fine-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Garrett	Fine-loamy, mixed, mesic	Pachic Argiustolls	Mollisols.
Gateson	Fine-loamy, mixed	Typic Eutroboralfs	Alfisols.
Gaynor	Fine, montmorillonitic, calcareous, mesic	Ustic Torriorthents	Entisols.
Glenberg	Coarse-loamy, mixed, calcareous, mesic	Ustic Torrifluvents	Entisols.
Gystrum	Fine-silty, gypsic, mesic	Ustollic Camborthids	Aridisols.
Harlan	Fine-loamy, mixed, mesic	Aridic Argiustolls	Mollisols.
Haverson	Fine-loamy, mixed, calcareous, mesic	Ustic Torrifluvents	Entisols.
Haverson, sandy subsoil variant	Fine-loamy over sandy or sandy-skeletal, mixed, calcareous, mesic.	Ustic Torrifluvents	Entisols.
Hazton	Loamy, mixed	Lithic Cryoborolls	Mollisols.
Heldt	Fine, montmorillonitic, mesic	Ustertic Camborthids	Aridisols.
Indart	Fine-loamy, mixed	Typic Cryoboralfs	Alfisols.
Jenkinson	Loamy, mixed	Lithic Cryoborolls	Mollisols.
Julesburg	Coarse-loamy, mixed, mesic	Aridic Argiustolls	Mollisols.
Keyner	Fine-loamy, mixed, mesic	Haplustollic Natrargids	Aridisols.
Kim	Fine-loamy, mixed, calcareous, mesic	Ustic Torriorthents	Entisols.
Kirtley	Fine-loamy, mixed, mesic	Aridic Argiustolls	Mollisols.
La Fonda	Fine-loamy, mixed, mesic	Ustollic Camborthids	Aridisols.
Leavitt	Fine-loamy, mixed	Argic Cryoborolls	Mollisols.
Limon	Fine, montmorillonitic, calcareous, mesic	Ustertic Torriorthents	Entisols.
Lohmiller	Fine, montmorillonitic, calcareous, mesic	Ustic Torrifluvents	Entisols.
Lohsman	Fine, montmorillonitic, mesic	Haplustollic Natrargids	Aridisols.
Lymanson	Fine-loamy, mixed	Argic Cryoborolls	Mollisols.
Mathers	Fine-loamy over sandy or sandy-skeletal, mixed.	Typic Cryoboralfs	Alfisols.
Maysdorf	Fine-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Moret	Loamy, mixed, nonacid, mesic	Lithic Ustic Torriorthents	Entisols.
Nathrop	Loamy-skeletal, mixed	Argic Cryoborolls	Mollisols.
Orella	Clayey, mixed, calcareous, mesic, shallow	Ustic Torriorthents	Entisols.
Otero	Coarse-loamy, mixed, calcareous, mesic	Ustic Torriorthents	Entisols.
Passcreek	Fine-loamy, mixed	Argic Cryoborolls	Mollisols.
Petrie	Fine, montmorillonitic, calcareous, mesic	Ustertic Torriorthents	Entisols.
Pineguest	Fine-loamy, mixed	Psammentic Cryoboralfs	Alfisols.
Pokeman	Fine-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Poker	Coarse-loamy, mixed	Argic Pachic Cryoborolls	Mollisols.
Potts	Fine-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Pugsley	Fine-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Razor	Fine, montmorillonitic, mesic	Ustollic Camborthids	Aridisols.
Redbank	Coarse-loamy, mixed, calcareous, mesic	Ustic Torrifluvents	Entisols.
Rekop	Loamy, gypsic, mesic, shallow	Ustic Torriorthents	Entisols.
Rencalson	Fine, montmorillonitic, mesic	Ustollic Haplargids	Aridisols.
Renohill	Fine, montmorillonitic, mesic	Ustollic Haplargids	Aridisols.
Rhoame	Fine, montmorillontic, nonacid, mesic	Ustic Torriorthents	Entisols.
Samsil	Clayey, montmorillonitic, calcareous, mesic, shallow.	Ustic Torriorthents	Entisols.

TABLE 7.—*Classification of soil series by higher categories*—Continued

Series	Family	Subgroup	Order
Sanford	Fine-loamy, mixed	Psammentic Cryoboralfs	Alfisols.
Sawcreek	Coarse-loamy, mixed	Typic Cryoborolls	Mollisols.
Schooner	Mixed, mesic	Lithic Torripsamments	Entisols.
Shingle	Loamy, mixed, calcareous, mesic, shallow	Ustic Torriorthents	Entisols.
Shirk	Fine-loamy, mixed, mesic	Aridic Haplustolls	Mollisols.
Simmont	Loamy-skeletal, mixed	Aridic Argiborolls	Mollisols.
Slipman	Fine-loamy, mixed	Boralfic Cryoborolls	Mollisols.
Slocum	Fine-loamy, mixed	Aquic Cryoborolls	Mollisols.
Southfork	Loamy, mixed, mesic, shallow	Ustollic Haplargids	Aridisols.
Spearfish	Loamy, mixed, calcareous, mesic, shallow	Ustic Torriorthents	Entisols.
Splitro	Loamy, mixed	Lithic Cryoborolls	Mollisols.
Starley	Loamy-skeletal, mixed	Lithic Cryoborolls	Mollisols.
Stoneham	Fine-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Stubbs	Fine-loamy, mixed	Argic Pachic Cryoborolls	Mollisols.
Sublette	Coarse-loamy, mixed	Argic Pachic Cryoborolls	Mollisols.
Sunup	Loamy-skeletal, mixed, calcareous, mesic	Lithic Ustic Torriorthents	Entisols.
Tassel	Loamy, mixed, calcareous, mesic, shallow	Ustic Torriorthents	Entisols.
Terry	Coarse-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Tolman	Loamy-skeletal, mixed	Lithic Argiborolls	Mollisols.
Travessilla	Loamy, mixed, calcareous, mesic	Lithic Ustic Torriorthents	Entisols.
Tripit	Fine-loamy, mixed	Argic Cryoborolls	Mollisols.
Turk	Very fine, illitic	Argic Cryoborolls	Mollisols.
Ulm	Fine, montmorillonitic, mesic	Ustollic Haplargids	Aridisols.
Valent	Mixed, mesic	Ustic Torripsamments	Entisols.
Wetterhorn	Fine, montmorillonitic	Typic Cryoboralfs	Alfisols.
Wolf	Fine-loamy, mixed, mesic	Aridic Argiustolls	Mollisols.
Woosley	Fine-loamy, mixed	Argic Cryoborolls	Mollisols.
Worf	Loamy, mixed, mesic, shallow	Ustollic Haplargids	Aridisols.
Wormser	Fine, montmorillonitic, mesic	Aridic Argiustolls	Mollisols.
Wyarno	Fine, montmorillonitic, mesic	Ustollic Haplargids	Aridisols.
Zigweid	Fine-loamy, mixed, mesic	Ustollic Camborthids	Aridisols.

the south- and west-facing slopes. This is reflected in the kind of vegetation and in the thickness of the soil profile.

Parent material

Parent material is the unconsolidated layer on the earth's surface in which soils form. The soils of this survey area formed in a variety of parent materials (fig. 10) that differ in grain size, porosity, mineralogy, and other characteristics. In the mountain areas the soils formed in residuum weathered from granite, limestone, olive calcareous shale, calcareous and noncalcareous sandstone, and reddish sandstone and shale. Among these are Burgess, Nathrop, Spearfish, and Turk soils.

On the mesa near Mayoworth, the soils formed in sediments of mixed origins on old alluvial fans and terraces. Among these are Big Horn and Wolf soils.

Parent materials from the east flank of the mountain extend to the east county line. They include pure, mixed, or interbedded reddish-colored siltstone, hard calcareous sandstone, alkaline shale, noncalcareous shale, and soft calcareous sandstone. Among the soils that formed in these parent materials are Spearfish, Briggsdale, Cushman, Lohsman, and Pugsley soils.

In some areas of the bottom lands, the soils formed in mixed alluvium. Among these are the Haverson and Glenberg soils. In other areas of the bottom lands, the soils formed in reddish-colored alluvium washed from the red beds. Among these are Barnum and Redbank soils.

In the area of Ninemile Creek, the soils formed in residuum weathered from sandstone, siltstone, or shale, but in the central part of the survey area, the Moret soils formed in residuum weathered from noncalcareous shale. Moret soils lack calcium carbonate, which is present in many other soils that formed in shale. Other soils in this area formed in mixed material. These are the Fort Collins, Kim, and Ulm soils.

Some soils formed in residuum or alluvium derived from very strongly alkaline shale and are generally very strongly alkaline. Among these are Absted, Bone, and Keyner soils.

Climate

Climate affects the kind of vegetation that grows in an area, the rate at which organic material decomposes, the rate at which minerals weather, and the depth to which chemical and physical changes extend in the soil. Areas below the mountains have warm summers, cold winters, and about 10 to 14 inches of precipitation annually. The mountain area has cool summers, cold winters, and about 15 to 19 inches of precipitation annually. Generally, as the elevation increases, temperature decreases and precipitation increases. At Sussex the average annual soil temperature is 52° F., the average annual precipitation is about 10 inches, and the elevation is 4,500 feet. At some mountain sites, the average annual soil temperature is 39° F., the average annual precipitation is 18 inches, and the elevation is about 8,000 feet.

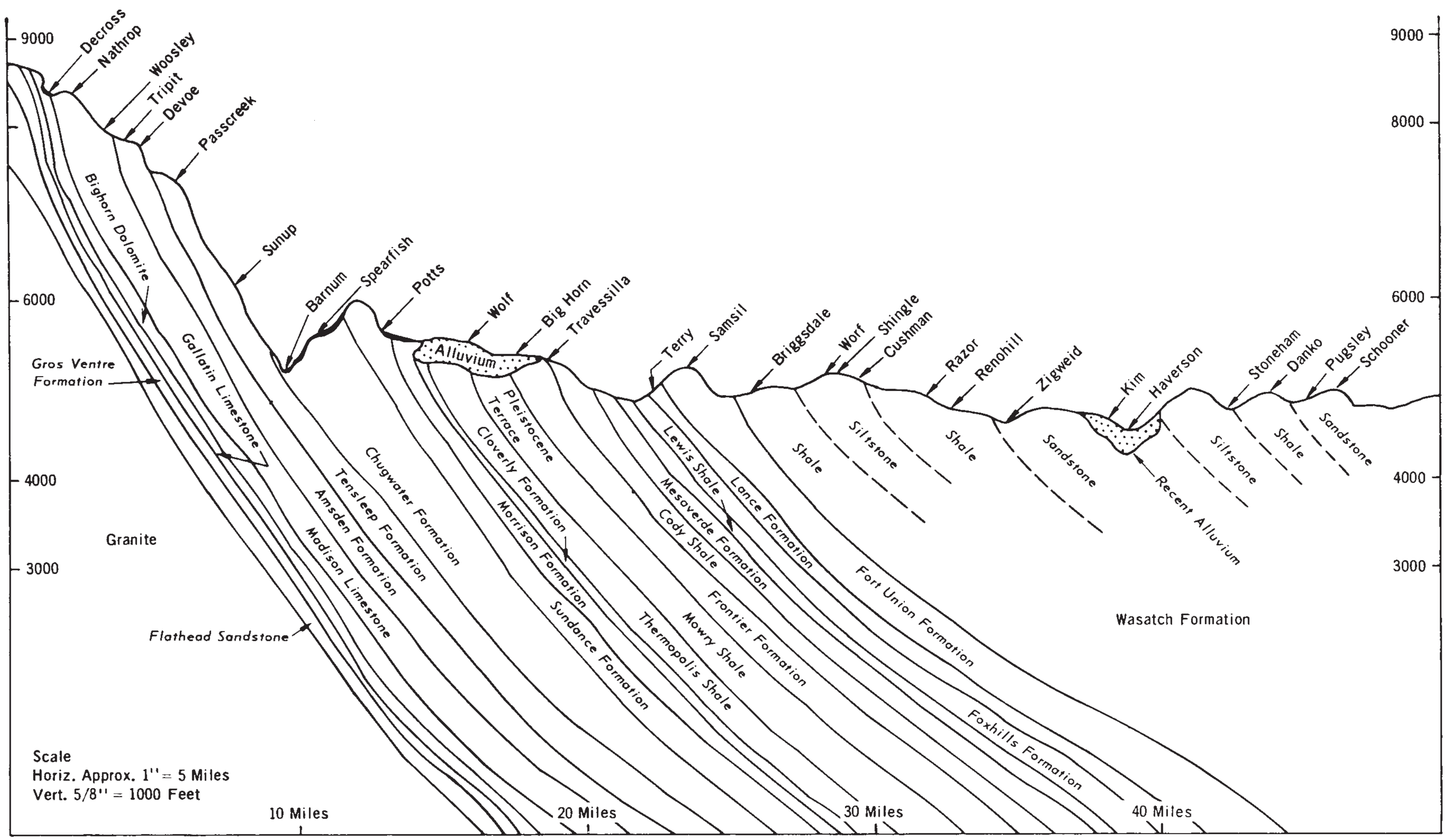

Figure 10.—**Relationship of some soils in the survey area to underlying geologic formations.**

Climate influences vegetation and the kind and amount of materials returned to the soil, which, in turn, affect organic-matter content and soil reaction. In the open mountain areas the soils are dark colored, which indicates a cool, moist climate and the return of considerable amounts of organic matter to the soil. Soils along the eastern boundary of the survey area are light colored. They formed in a warm, semiarid climate where much less organic material is returned to the soil than in the mountain area.

There are differences in effective climate within broad climatic zones. North-facing slopes generally are cooler and more moist than south-facing slopes because the sun's rays do not strike them as directly and moisture is retained longer.

Living organisms

Different types of vegetation remove different kinds and amounts of nutrients from the soil and return different kinds of residue to it. Soils of the alluvial bottoms, such as Glenberg and Haverson soils, have been influenced only slightly by the native vegetation of western wheatgrass, big sagebrush, and cottonwood trees. Soils that formed in the open mountain parks, such as Decross and Woosley soils, have a dark-colored surface layer that in many places is quite thick because of the kind of materials returned to the soil. Soils that formed in the mountains under pine or spruce cover, such as Cloud Peak and Dell soils, have a thin, dark-colored surface layer and a leached subsurface layer. These leached layers are neutral to moderately acid because of the chemical changes brought about by a forest litter of pine needles.

Animal activity also affects the formation of soils. Burrowing animals, such as rodents, badgers, and prairie dogs, dig into the soil and mix the materials of various horizons. Earthworms are also responsible for the mixing of soil materials. In some areas such animals as prarie dogs destroy all the vegetation around their burrows. This destruction affects soil formation and also increases the hazard of erosion.

Time

The length of time that soil materials have been in place is an important factor in soil formation. The kinds and distinctness of horizons depend, in part, on the length of time that the other soil-forming factors have been active. The soil materials along stream channels have been in place a relatively short time. Soils that formed in material along stream channels, such as those of the Barnum and Haverson series, show little or no change from the original soil material. On some alluvial fans where soils such as those of the Kim and Zigweid series have been in place longer than soils along stream channels, indistinct horizons have formed in places. Soils of the uplands, such as those in the area of Ninemile Creek and Fourmile Creek, have formed on old land surfaces. Among these are the Briggsdale and Renohill soils that have physical and chemical properties that reflect the full impact of soil-forming processes. Big Horn soils formed on old high terraces and also show a high degree of physical and chemical change.

Classification of the Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed in narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 (*2*) and revised later (*5*). The system currently used by the National Cooperative Soil Survey was developed in the early sixties (*7*) and was adopted in 1965 (*4*). It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

ORDER.—Ten soil orders are recognized. The differentiae for the orders are based on the kind and degree of the dominant soil-forming processes that have taken place. Each order is named with a word of three or four syllables, ending in *sol*. An example is Mollisol.

SUBORDER.—Each order is divided into suborders, based mainly on properties that influence soil genesis and that are important to plant growth. In some cases they reflect what seems to be the most important variables within the orders. The names of suborders have exactly two syllables. The last syllable indicates the order. An example is Boroll (*Bor*, meaning cool, plus *oll*, from Mollisol).

GREAT GROUP.—Soil suborders are separated into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons, soil moisture, and temperature regimes, and in base status. The names of great groups have three or four syllables and end with the name of a suborder. A prefix added to the name suggests something about the properties of the soil. An example is Cryoboroll (*Cry*, meaning cold, plus *boroll*, the suborder of Mollisols that are in cool or cold climates).

SUBGROUP.—Great groups are divided into three kinds of subgroups: the central, or typic, concept of the great groups (not necessarily the most extensive subgroup); the intergrades, or transitional forms to other orders, suborders, or great groups; and extragrade subgroups that have some properties that are representative of the great groups but do not indicate transitions to any other known kind of soil. The names of subgroups are derived by placing one or more adjectives in front of the name of the great group. The adjective Typic is used for the subgroup that is thought to typify the great group. An example is Typic Cryoboroll.

FAMILY.—Soil families group within a subgroup those soils that have similar enough physical and chemical properties that responses to management and manipulation for use are nearly the same for comparable phases. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineralogy, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for particle size, mineralogy, soil depth, and other characteristics that are used as family differentiae. An example is Typic Cryoborolls, loamy, mixed, shallow.

SERIES.—The series consists of a group of soils that formed in a particular kind of parent material and have horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition. The names are place names taken from the area where the soil is first defined. An example is Devoe series.

Laboratory Analyses

Table 8 shows the result of laboratory analyses of various samples taken from selected soil profiles and from selected horizons of certain soils. The samples were analyzed and the determinations made by the Soil Survey Laboratory, Soil Conservation Service, Lincoln, Nebraska. Results are reported for the fine-earth fraction, in which the particles are less than 2 millimeters in size, unless otherwise indicated. Dashes indicate that no analysis was made or that analysis was made but nothing was found.

In the following paragraphs, the analyses are briefly described. The analyses were made according to procedures outlined in Soil Survey Investigations Report No. 1 (*8*), and the method used for each analysis is in parentheses at the end of each paragraph.

Particle-size distribution is the amount of various soil separates. The percentages for particles that are less than 2 millimeters in size. After organic matter was destroyed, the sand fraction was determined through sieving, and the silt and clay fractions were determined through sedimentation (Method 3A1).

Reaction was determined by measuring the pH (hydrogen ion concentration) with a glass electrode in a 1:1 soil-water suspension (Method 8C1a).

Organic carbon is the amount of carbon in organic matter. Most organic matter contains about 58 percent carbon; therefore, the percentage of organic carbon multiplied by 1.72 results in the percentage of organic matter. Organic carbon was determined by wet combustion (Method 6A1a).

Carbonate as $CaCO_3$ refers to calcium and magnesium carbonate (limestone) expressed as calcium carbonate. This was determined by treatment with hydrochloric acid and measurement of the amount of CO_2 formed in a manometer (Method 6E1b).

Extractable bases are the basic cations (calcium, magnesium, sodium, and potassium) held by the soil. In table 8 they are expressed in milliequivalents per 100 grams of soil. The amounts were determined by measuring the amount of basic cations in the ammonium acetate solution used to saturate the soil in the cation exchange capacity determination. Carbonates, if present, may be dissolved in this analysis (Method 5B1a).

Cation exchange capacity is the ability of the soil to hold cations. In this table it is expressed in milliequivalents per 100 grams of soil. It was determined by saturating the soil with an ammonium acetate (pH 7.0) solution and measuring the amount of ammonium retained (Method 5A1a).

Extractable acidity is the acidity, mainly in acid aluminum compounds, of the soil expressed in milliequivalents per 100 grams of soil. It was measured by extracting acidity with a triethanolamine solution of pH 8.2 (Method 6H1a). The sum of extractable bases and extractable acidity generally is slightly larger than the cation exchange capacity (NH_4O Ac).

Base saturation is the sum of bases expressed as a percent of the cation exchange capacity, as specified.

Bulk density, one-third bar, is the weight in grams of a unit volume, in cubic centimeters, of undisturbed soil. Bulk density is determined from the volume of the soil clod used for water content at one-third bar (Method 4A1d).

Coeffcient of linear extensibility is a measure of the swelling of a soil on wetting. It is the ratio between the length of a moist soil clod and the length of a dry one (Method 4D1).

Water content, one-third bar, is the amount of water, in percent, held by the soil against a pressure of one-third bar (5 pounds per square inch). The water content at one-third bar approximates field capacity if underlying horizons do not contrast greatly in texture or otherwise restrict water movement. One-third bar water retention is measured by equilibrating undisturbed soil clods in a pressure cooker apparatus (Method 4B1c).

Water content, 15 bar, is the amount of water held by the soil against a pressure of 15 bar (220 pounds per square inch). This water generally cannot be used by crops. Fifteen-bar water retention is measured in a pressure membrane apparatus on crushed samples (Method 4B2).

All of the soils in this survey area are described in the section "Descriptions of the Soils." Some variations exist in depth and horizon designation between the representative profile and the laboratory data shown in table 8. These variations are normal, because many of the samples were taken at sites other than the type location.

Additional laboratory data for Fort Collins, Glenberg, Haverson, Kim, Renohill, Stoneham, Terry, and Ulm soils are published in Soil Survey Investigations Report No. 8, Soil Conservation Service, U.S. Department of Agriculture. These soils were sampled at places outside the survey area.

General Nature of the Area

In 1864, when the Bozeman Trail was established, settlers began moving into and through the survey area, and in 1865 the Army established Fort Conner, later named Fort Reno, on the Powder River. The location of this fort

was down the Powder River from the present community of Sussex.

The original name for the area was Pease County. It was changed to Johnson County in 1879, and the charter for the town of Buffalo, the county seat, was approved in 1884. The town of Kaycee was established in 1887; its name was derived from the old "KC" Ranch.

The area became the headquarters for many owners of large cattle herds, and many homesteads were taken up. During the period 1890 to 1895, the influx of people into the area forced the ranchers to fence what had been open range and to file for irrigation rights along the main streams. From 1915 to 1920 many homesteads were taken up in the area of Ninemile Creek and Fourmile Creek, and the homesteaders were fairly successful until the late 1920's.

At present, farming in the southern part of Johnson County is centered around the raising of livestock. There is about 1,156,085 acres of range, 35,152 acres of woodland, 17,482 acres that is irrigated, 4,472 acres of dryland crops, and 9,784 acres used both for woodland and range. The range is used to graze cattle, sheep, horses, and a small herd of buffalo. Many ranches have summer range on private, State, or Federal lands on the southern end of the Big Horn Mountains. Range is generally grazed from late April through November or early December, but some ranches use the range the year round and supplement the feed for livestock with concentrates in winter and spring.

The irrigated areas are used mainly for the hay and small grain that supplement livestock feed, but some produce hay and grain as cash crops. The principal hay crops are alfalfa and bromegrass, and the small grains are barley and oats. On a few ranches corn is grown for ensilage. Irrigated pasture is used to graze livestock in summer.

Data from the Johnson County ASCS Office in Buffalo indicate that, of the 4,472 acres in the dryland area, 792 acres was farmed in 1969. The principal crop is spring wheat that is used partly as a cash crop but mainly for livestock feed. Other uses of dryland areas are hay, tame pasture, and fallow.

The county seat, Buffalo, is in the northern part of the county. In the southern part are the towns of Kaycee and Linch. According to the 1970 census, Kaycee has a population of 272, and Linch, a population of 300. Other community centers are Barnum, Mayoworth, and Sussex.

Among the industries in the southern part of Johnson County are many oilfields, many pits west and south of Kaycee where bentonite is mined, and a few sawmill operations that work the timber stands in the Big Horn Mountains.

Transportation is available through airline connections in Casper and Sheridan and railroads that provide for shipping of freight or livestock at Casper and Clearmont. Incoming or outgoing freight is also shipped by private or commercial trucking. The area is served by an Interstate Highway, which runs north and south, and a U.S. Highway that parallels the Interstate. Oiled State highways run west from Kaycee to Barnum, northwest from Kaycee to Mayoworth, east from Kaycee to Sussex, and southeast from Sussex to Linch.

Geology [5]

Johnson County, Southern Part, is along the east flank of the Big Horn Mountains and extends out onto the floor of the Powder River Basin to the east. The Big Horn Mountains are anticlinal in geologic structure, and the Powder River Basin is synclinal. The formation of this range and basin occurred during the Rocky Mountain orogeny at the close of Cretaceous time. The Cretaceous and older rock beds are folded and have been exposed by erosion along the flank of the Big Horn Mountains. The flat-lying Wasatch Formation of Tertiary age occupies the floor of the Powder River Basin in the eastern half of the survey area. The core of the Big Horn Mountains consists of Precambrian igneous rocks. The sedimentary rocks, which consist of dolomite, limestone, sandstone, and shale and which are exposed along the flank of the mountain, represent all the geologic ages from Cambrian to Tertiary, except the Silurian. Figure 10, page 144, shows a cross section of the area and the geologic formation.

Climate [6]

Johnson County, Southern Part, is in the north-central part of Wyoming. Its western border lies along the summit of the Big Horn Mountains. Elevations in this area range from 8,000 to 9,000 feet. A few miles to the north, the Big Horn Mountains rise to elevations of more than 12,000 feet, culminating at Cloud Peak, elevation 13,175 feet. The Big Horns occupy the western one-fifth of this area. East of the Big Horns are rolling grasslands that have elevations of about 5,000 feet. The South Fork of Powder River enters the survey area at about the midpoint east and west and flows generally in a north-northeast direction. It is joined east of Kaycee by the Middle Fork and North Fork of the Powder River, which flow from the Big Horns.

Precipitation generally is the result of frontal weather systems and weather activity in upslope areas during winter and of thermal activity during summer. The survey area is in the latitude of prevailing westerlies. The numerous mountain ranges between this area and the West Coast, especially the Big Horns, form an effective barrier to moisture. This survey area also receives cold air from Canada because there are no mountains to the north to halt its passage southward. Most of the cold air masses do not stay for more than 3 days because the prevailing winds, which are westerly, and the relief, which is generally downslope toward the east, tend to force the cold air out. As westerly winds move downslope and as the accompanying air warms by compression, winter temperatures are greatly modified. In grassland areas, the climate is classified as semiarid.

In Johnson County, Southern Part, there is a wide range between temperatures in summer and those in winter and between the maximum and minimum temperatures each day. These differences are a result of the high elevation and dry air, which permit rapid incoming and outgoing radiation and the passage of both warm and cold air masses. Cold air outbreaks from Canada gen-

[5] By JOHN W. MCLELLAN, geologist, Soil Conservation Service, Casper, Wyoming.

[6] By JOHN D. ALYEA, State climatologist for Wyoming, National Weather Service, U.S. Department of Commerce.

TABLE 8.—*Physical and chemical*

[Analysis made at Soil Survey Laboratory, Soil Conservation Service, Lincoln, Nebraska.

Soil, sample number, and sample location	Horizon	Depth from surface	Coarse fragments (75–2.0 mm.)	Particle-size distribution: Very coarse and coarse sand (2.0–0.5 mm.)	Medium sand (0.5–0.25 mm.)	Fine sand (0.25–0.10 mm.)	Very fine sand (0.10–0.05 mm.)	Silt (0.05–0.002 mm.)	Clay (<0.002 mm.)
		Inches	*Percent of whole soil*						
Absted very fine sandy loam:									
S66–Wyo–10–12; NW¼SW¼ sec. 4, T. 44 N., R. 80 W.	B2t	4–8	[1]	0. 3	0. 3	6. 5	21. 6	27. 5	43. 8
	B31	8–13	--------	. 3	. 3	4. 7	20. 6	39. 2	34. 9
	C2	28–32	--------	. 4	. 2	8. 2	31. 0	36. 5	23. 7
Bachus loam:									
S67–Wyo–10–8; NE¼NE¼ sec. 29, T. 45 N., R. 85 W.	A11	0–3	10	5. 7	8. 5	15. 7	8. 4	43. 5	18. 2
	A12	3–6	10	5. 0	7. 0	13. 2	8. 9	47. 2	18. 7
	B1	6–12	10	5. 1	6. 7	12. 3	9. 4	47. 6	18. 9
	B21t	12–16	10	5. 9	7. 5	13. 6	10. 0	43. 3	19. 7
	B22t	16–26	15	6. 8	8. 2	14. 4	10. 3	38. 1	22. 2
Big Horn loam:									
S66–Wyo–10–9; NW¼NW¼ sec. 4, T. 45 N., R. 82 W.	B21t	5–12	--------	. 1	. 3	4. 5	19. 8	33. 3	42. 0
Briggsdale fine sandy loam:									
S66–Wyo–10–11; SW¼SW¼ sec. 29, T. 45 N., R. 80 W.	B21t	8–12	--------	. 2	. 7	12. 4	27. 2	24. 5	35. 0
Cloud Peak loam:									
67–Wyo–10–10; SW¼ SW¼ sec. 23, T. 45 N., R. 85 W.	A11	0–1	[1]	. 5	. 5	1. 5	11. 8	64. 3	21. 3
	A12	1–3	[1]	. 5	. 3	1. 6	12. 2	65. 7	19. 7
	A2	3–5	[1]	. 4	. 4	1. 6	14. 1	66. 1	17. 4
	BA	5–8	1	. 4	. 3	1. 6	12. 4	55. 9	29. 3
	B21t	8–13	3	. 8	. 3	1. 6	13. 0	45. 5	38. 8
	IIB22t	13–20	55	1. 6	. 4	2. 6	20. 4	46. 5	28. 5
	IIB3	20–33	55	2. 5	. 7	4. 4	19. 0	49. 3	24. 1
Dell loam:									
S66–Wyo–10–5; SW¼SW¼ sec. 23, T. 45 N., R. 85 W.	B2t	11–17	[1]	. 3	. 3	1. 6	12. 7	45. 1	40. 0
Fort Collins fine sandy loam:									
S66–Wyo–10–10; NW¼SE¼ sec. 25, T. 45 N., R. 82 W.	B21t	4–9	[1]	. 2	1. 1	30. 1	22. 2	23. 4	23. 0
Kim loam:									
S69–Wyo–10–1; NE¼SW¼ sec. 10, T. 43 N., R. 78 W.	A1	0–3	[1]	. 3	. 4	11. 4	26. 2	38. 6	23. 1
	C1	3–10	[1]	. 4	. 5	10. 5	24. 3	40. 3	23. 9
	C2	10–21	[1]	. 6	. 4	8. 8	22. 6	42. 1	25. 6
	C1ca	21–34	[1]	. 3	. 5	11. 5	24. 4	39. 4	23. 8
	C2ca	34–45	[1]	. 4	. 6	12. 3	26. 3	39. 5	20. 9
Mathers loam:									
S67–Wyo–10–1; SW¼SW¼ sec. 24, T. 47 N., R. 85 W.	A11	0–3	10	24. 8	5. 3	6. 6	6. 6	46. 2	10. 6
	A12	3–6	15	31. 9	5. 9	7. 1	6. 6	40. 3	8. 1
	A2	6–9	25	35. 8	8. 1	9. 5	6. 8	32. 7	7. 1
	B&A	9–12	25	32. 1	10. 8	12. 9	7. 4	17. 4	19. 4
	B21t	12–20	20	34. 9	10. 8	12. 4	6. 5	8. 1	27. 4
	B22t	20–26	28	52. 9	11. 1	1. 7	4. 6	6. 3	12. 3
	B3	26–39	30	54. 7	10. 4	12. 8	5. 0	6. 0	11. 1
	C1	39–49	27	65. 5	9. 5	10. 5	3. 5	5. 1	5. 8
	C2	49–61	29	56. 2	9. 9	11. 3	5. 0	6. 5	11. 1
	C3	61–72	34	51. 2	12. 2	16. 0	6. 5	6. 6	7. 6
Shingle loam:									
S69–Wyo–10–5; NW¼NW¼ sec. 21, T. 45 N., R. 80 W.	C1ca	2–6	--------	. 3	. 4	10. 2	30. 7	36. 8	21. 6
	C2ca	6–9	--------	. 1	. 2	8. 0	27. 7	41. 5	22. 5

data for selected soils

Dashes indicate that analysis was made, but nothing was found]

Reaction H_2O 1:1	Organic carbon	Carbonate as $CaCO_3$	Extractable bases				Cation exchange capacity NH_4O Ac.	Extractable acidity	Base saturation NH_4O Ac.	Bulk density 1/3 bar	Coefficient of linear extensibility	Water content	
			Ca	Mg	Na	K						1/3 bar	15 bar
pH	*Percent*	*Percent*	*Meq./100 gm. of soil*	*Meq./100 gm. of soil*	*Meq./100 gm. of soil*	*Meq./100 gm. of soil*	*Meq./100 gm. of soil*	*Meq./100 gm. of soil*	*Percent*	*Gm./cc.*		*Percent*	*Percent*
[2] 8.4	0.7	2	14.3	12.2	4.3	0.6	28.6	--------	--------	--------	--------	--------	15.9
[3] 8.7	--------	7	9.8	9.5	4.4	.5	20.5	--------	--------	--------	--------	23.1	13.2
[4] 8.3	--------	3	8.0	6.8	4.6	.4	16.0	--------	--------	1.51	0.03	--------	8.6
5.4	5.1	--------	13.9	2.6	.1	1.3	24.0	13.6	75	1.20	.03	23.1	10.4
5.4	2.2	--------	9.0	2.2	.1	1.0	18.3	11.7	67	1.21	.02	23.9	8.6
5.2	1.1	--------	6.2	2.1	.1	.6	14.6	10.3	62	1.19	.01	16.8	7.9
5.0	.9	--------	5.7	2.0	.1	.4	14.4	10.6	57	1.40	--------	--------	8.1
4.9	.6	--------	6.8	2.5	.1	.3	17.0	12.6	57	1.38	.01	18.3	9.4
7.0	.9	(1)	12.9	11.1	.1	1.1	25.4	--------	--------	--------	--------	--------	14.4
7.4	.7	(1)	15.5	8.7	.3	.7	25.5	--------	--------	--------	--------	--------	13.1
5.6	19.5	--------	43.1	8.7	.1	.6	60.0	25.5	89	.40	--------	--------	48.5
5.9	4.6	--------	20.9	4.6	.1	.8	29.9	12.6	89	1.25	.02	28.0	18.2
6.0	1.3	--------	9.7	3.4	.1	.5	15.9	7.2	86	1.36	.01	25.2	12.0
6.2	1.1	--------	13.0	6.6	.1	.7	22.3	6.4	91	1.25	.03	26.2	17.5
7.0	1.4	(1)	19.5	11.7	.1	.9	31.7	5.7	100	1.27	.06	28.2	22.1
7.4	1.3	15	15.5	8.5	.1	.6	26.7	--------	--------	1.50	--------	--------	17.3
7.5	1.1	23	15.1	8.4	.1	.5	24.9	--------	--------	1.50	--------	--------	15.6
6.9	--------	1	18.0	9.4	.1	.8	28.7	--------	--------	--------	--------	--------	16.9
7.4	.7	(1)	14.6	6.7	(1)	.6	22.1	--------	--------	--------	--------	--------	9.5
8.1	.3	2	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	8.0
7.9	.4	2	14.2	2.2	.4	.6	16.4	--------	--------	--------	--------	--------	7.5
8.3	.3	2	--------	--------	--------	--------	--------	--------	--------	1.45	.02	19.0	7.6
8.5	.4	3	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	8.1
8.4	.3	2	11.4	2.4	2.4	.6	15.1	--------	--------	--------	--------	--------	6.9
5.3	3.7	--------	7.3	1.3	.1	.7	16.9	15.6	56	1.16	.02	24.0	6.2
5.5	.7	--------	4.3	.9	.1	.4	9.0	5.8	63	1.55	.01	22.4	4.3
5.4	.3	--------	3.4	1.0	.1	.2	6.7	4.2	70	1.53	--------	19.1	3.2
5.2	.3	--------	8.3	2.9	.1	.4	14.4	4.8	81	1.50	--------	--------	7.3
5.3	.4	--------	18.3	7.0	.1	.7	29.3	5.4	89	1.60	.01	18.3	12.3
5.1	.2	--------	9.3	3.4	.1	.4	15.3	4.3	86	--------	--------	--------	4.6
5.3	.1	--------	10.1	3.5	.1	.4	15.6	2.8	90	--------	--------	--------	6.6
5.3	(1)	--------	7.7	2.7	.1	.3	11.3	2.3	96	--------	--------	--------	3.6
5.6	(1)	--------	7.9	3.8	.1	.3	15.8	3.0	96	--------	--------	--------	5.4
5.6	(1)	--------	7.0	2.3	.1	.3	10.0	2.4	97	--------	--------	--------	2.8
7.9	1.4	2	16.1	2.2	.1	.5	17.3	--------	--------	--------	--------	--------	9.2
8.1	1.0	5	15.3	3.1	.4	.4	18.6	--------	--------	1.46	.02	19.3	9.9

TABLE 8.—*Physical and chemical*

Soil, sample number, and sample location	Horizon	Depth from surface	Coarse fragments (75–2.0 mm.)	Particle-size distribution					
				Very coarse and coarse sand (2.0–0.5 mm.)	Medium sand (0.5–0.25 mm.)	Fine sand (0.25–0.10 mm.)	Very fine sand (0.10–0.05 mm.)	Silt (0.05–0.002 mm.)	Clay (<0.002 mm.)
		Inches	*Percent of whole soil*						
Splitro sandy loam: S67–Wyo–10–9; NE¼NE¼ sec. 30, T. 45 N., R. 85 W.	A11	0–4	10	10.7	15.5	22.6	6.6	31.4	13.1
	A12	4–10	10	6.9	12.6	22.4	8.2	35.6	14.3
	C	10–17	10	7.7	13.8	23.1	7.6	34.2	13.5
Stoneham sandy loam: S69–Wyo–10–7; NW¼SE¼ sec. 25, T. 45 N., R. 82 W.	B2t	4–9	--------	.2	1.5	25.1	19.3	28.7	25.3
Turk clay loam: S67–Wyo–10–6; NE¼NE¼ sec. 28, T. 45 N., R. 85 W.	A1	0–3	10	2.7	.9	3.6	9.9	46.9	36.0
	B1	3–7	10	1.7	.4	1.7	5.3	30.5	60.3
	B2t	7–12	5	1.3	.4	1.7	3.6	25.4	67.6
	B31ca	12–18	5	1.5	1.0	3.0	4.1	28.1	61.2
	B32ca	18–32	5	1.8	1.1	3.9	5.0	38.7	49.2
	Cca	32–37	--------	1.1	.2	.7	7.1	58.9	31.9
Valent loamy sand: S66–Wyo–10–13; SE¼SE¼ sec. 16, T. 45 N., R. 78 W.	C1	11–23	--------	3.1	19.0	46.2	16.0	8.8	6.9
Woosley loam: S67–Wyo–10–13; NW¼NE¼ sec. 6 T. 45 N., R. 84 W.	A11	0–2	10	1.2	1.9	6.8	13.2	51.4	25.5
	A12	2–6	10	.7	1.2	5.3	12.4	52.9	27.5
	B11	6–10	10	.9	1.1	4.6	13.5	49.8	30.1
	B2t	10–17	10	.5	.8	3.3	14.6	53.8	27.0
	B3ca	17–25	10	2.0	1.0	3.5	16.0	52.8	24.7
	C1ca	25–40	--------	2.8	3.0	6.9	13.1	46.5	28.7
Worf loam: S69–Wyo–10–4; NW¼NW¼ sec. 21, T. 45 N., R .80 W.	A1	0–2	(1)	.3	.9	11.7	31.2	39.6	16.3
	B2t	2–7	(1)	.4	.3	7.0	24.8	39.6	27.9
	B3ca	7–17	--------	.1	.2	2.8	16.0	54.4	26.5

[1] Trace.
[2] Exchangeable sodium percentage is 13.

data for selected soils—Continued

Reaction H_2O 1:1	Organic carbon	Carbonate as $CaCO_3$	Extractable bases				Cation exchange capacity NH_4O Ac.	Extractable acidity	Base saturation NH_4O Ac.	Bulk density 1/3 bar	Coefficient of linear extensibility	Water content	
			Ca	Mg	Na	K						1/3 bar	15 bar
pH	*Percent*	*Percent*	*Meq./100 gm. of soil*	*Meq./100 gm. of soil*	*Meq./100 gm. of soil*	*Meq./100 gm. of soil*	*Meq./100 gm. of soil*	*Meq./100 gm. of soil*	*Percent*	*Gm./cc.*		*Percent*	*Percent*
5.0	1.8	--------	4.1	1.0	(1)	0.8	11.1	8.3	53	1.28	0.01	23.7	7.1
5.1	1.3	--------	4.4	1.4	0.1	.5	11.9	1.2	54	1.35	.01	21.9	7.8
5.0	.9	--------	4.5	1.1	.1	.4	11.7	11.6	44	1.26	.01	21.3	7.3
7.8	.8	(1)	19.5	8.3	.1	.6	23.8	--------	--------	--------	--------	--------	10.2
6.8	5.7	--------	19.4	4.7	.1	2.9	25.7	5.1	105	1.01	.05	37.9	17.2
6.8	2.0	(1)	15.8	7.9	.1	3.1	27.7	4.6	97	1.33	.04	23.9	20.3
7.5	1.4	1	13.4	10.1	.2	3.1	27.8	1.3	--------	1.40	.07	27.0	22.2
8.0	.8	10	10.9	9.9	.4	2.2	20.2	--------	--------	1.50	.06	24.6	19.5
8.2	.4	24	7.8	10.9	1.1	1.4	17.4	--------	--------	1.60	.05	21.3	17.0
8.3	.3	37	6.3	7.9	1.1	.9	10.9	--------	--------	--------	--------	--------	12.4
--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------	--------
5.9	8.7	--------	27.6	5.6	.1	1.7	38.2	13.6	92	.83	.05	53.8	23.4
6.2	3.6	--------	23.2	6.0	.1	.9	31.4	7.9	96	1.04	.04	36.1	13.5
6.5	2.2	(1)	22.0	7.6	.1	.7	30.4	6.0	100	1.14	.04	30.3	13.1
6.9	1.7	1	17.2	6.9	.1	.6	29.2	3.6	--------	1.21	.03	29.5	11.8
7.7	1.0	16	17.1	5.7	.1	.5	21.3	.3	--------	1.30	.02	25.8	10.0
8.1	.6	52	12.7	7.9	.1	.4	18.0	--------	--------	1.28	.02	27.5	12.0
7.1	1.3	(1)	9.6	3.1	.1	.8	13.2	--------	--------	--------	--------	--------	6.6
7.6	1.2	2	15.9	4.6	.2	.9	21.2	--------	--------	1.39	.04	16.6	10.7
8.4	.7	11	13.8	5.1	.9	.6	17.8	--------	--------	--------	--------	--------	10.3

[3] Exchangeable sodium percentage is 18.
[4] Exchangeable sodium percentage is 16.

529-425—75— -11

erally do not last long, because their path is usually southeasterly in these latitudes; consequently, the survey area is in the western edge of the cold air mass for a limited period of time. This survey area is subject to abrupt, sometimes large changes in temperature as well as in other weather features.

Table 9 gives temperature and precipitation data; table 10 shows probabilities of specified low temperatures in spring and fall; and table 11 gives evapotranspiration and precipitation data.

Some extremes not shown in table 9 are a high temperature of 98° in September 1940 and a low temperature of 51° below zero on February 12, 1905. Because there is rapid cooling from radiation at night and from cold air outbreaks from Canada, freezes late in spring and early fall are fairly common. Table 10 shows that the average last occurrences of 32° F. and 28° F. in fall are September 13 and 24, respectively. This gives an average growing season of 106 days between temperatures of 32° in spring and fall and 132 days between temperatures of 28°. Table 10 also shows that in only 20 percent of the years would the temperature at Kaycee in spring be expected to drop to 32° or lower after June 8 or to 28° or lower after May 23; and that in fall be expected to drop to 32° or lower before September 2 or to 28° or lower before September 13.

The normal pattern at Kaycee shows that precipitation is lightest in the period December through February, increases to a peak in the last half of May and the first half of June, decreases rapidly in amount from the last

TABLE 9.—*Temperature*

[Based on records kept at Kaycee, elevation

Month	Temperature						
	Average daily maximum	Average daily minimum	Average monthly	Two years in 10 will have at least 4 days with—		Average number of days with—	
				Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—	Maximum temperature of—	
						90° and above	32° and below
	° F.	° F.	° F.	° F.	° F.		
January	37. 4	5. 7	21. 6	55	−21	0	10
February	41. 0	11. 0	26. 0	58	−9	0	7
March	45. 3	16. 7	31. 0	65	−4	0	5
April	57 8	27. 9	42. 9	75	16	0	(¹)
May	67. 3	37. 5	52. 4	83	27	(¹)	(¹)
June	76. 5	44. 5	60. 5	91	34	3	0
July	87. 8	50. 8	69. 3	97	42	14	0
August	86. 6	48. 4	67. 5	96	39	13	0
September	75. 3	39. 1	57. 2	91	28	3	(¹)
October	64. 7	29. 3	47. 0	81	18	0	(¹)
November	48. 1	17. 2	32. 7	66	−3	0	4
December	40. 8	10. 0	25. 4	56	−12	0	7
Year	60. 7	28. 2	44. 5			33	33

¹ Less than half a day.

half of June to a low in August, increases again to a secondary peak in September, and then decreases to the minimum in winter. Normally, at Kaycee 4.1 inches, or about 35 percent, of the annual precipitation falls between dates in spring and fall when the temperature is 32°, and 5.9 inches, or about 51 percent, falls between the average dates in spring and fall when the temperature is 28°. The greatest precipitation measured in any 1 month in Kaycee was 6.12 inches during June 1964 and the least was only a trace that was recorded for a period of several months. Kaycee's greatest 1-month snowfall was 32.4 inches, during April 1955.

Sunshine is quite abundant in the survey area, and only a few days during the year are without some sunshine. The duration of sunshine in the survey area is not recorded on Weather Service instruments, but it is estimated to average about 65 percent of possible sunshine on an annual basis and ranges from about 55 percent in winter to about 75 percent late in summer.

Relative humidity is comparatively low during the year, and it is estimated to average about 60 percent. It ranges from about 70 percent in December to about 47 percent during August. The average daily ranges during midwinter are estimated to be 75 percent in early morning and 60 percent in the heat of the day, and during midsummer 60 percent in early morning and 30 percent in the heat of the day.

Winds are estimated to average about 8 to 10 miles per hour annually and range from an hourly speed of about 10 to 12 miles per hour during spring to an hourly speed of 7 miles per hour late in summer. Daytime winds are typically stronger than nighttime winds, and occasional storms can bring brief periods of high winds that gust to more than 75 miles per hour.

and precipitation data

4,660 feet, for the period 1941 to 1967]

Temperature—Con.		Precipitation							
Average number of days with—Con.				One year in 10 will have—		Snow and sleet			
Minimum temperature of—		Average total	Maximum daily	Less than—	More than—	Average total	Maximum monthly	Maximum daily	Average number of days with 0.10 inch or more
32° and below	0° and below								
		Inches	*Inches*	*Inches*	*Inches*	*Inches of snow*	*Inches of snow*	*Inches of snow*	
31	10	0.40	0.58	0.05	0.70	7.0	24.2	8.1	1
28	6	.32	.40	.04	.66	6.0	20.9	8.7	1
30	3	.61	.56	.18	1.20	6.4	14.5	5.1	2
21	[1]	1.56	1.52	.60	2.98	6.4	32.4	22.0	4
7	0	1.97	1.60	.91	3.54	2.8	17.6	11.7	6
1	0	2.20	3.62	.79	4.24	.1	1.4	1.4	6
0	0	1.01	.92	.12	1.99	0	0	0	3
[1]	0	.66	1.72	.17	1.62	0	0	0	2
6	0	1.09	1.19	.19	1.82	.6	7.3	4.2	3
22	[1]	.82	1.58	.15	1.52	2.9	8.2	8.0	2
29	3	.51	.39	.23	1.03	6.0	17.2	7.8	2
30	7	.35	.45	.09	.70	6.3	14.5	6.0	1
205	29	11.50	3.62	------------	------------	44.5	32.4	22.0	33

TABLE 10.—*Probabilities of specified low temperatures in spring and fall*

[All data based on records kept at Kaycee for the period 1941 to 1967]

Probability	Dates for given probability and temperature of—		
	24° F. or lower	28° F. or lower	32° F. or lower
Spring:			
1 year in 10 later than	May 14	May 28	June 13
2 years in 10 later than	May 9	May 23	June 8
5 years in 10 later than	April 29	May 13	May 29
Fall:			
1 year in 10 earlier than	September 19	September 7	August 27
2 years in 10 earlier than	September 25	September 13	September 2
5 years in 10 earlier than	October 6	September 24	September 13

TABLE 11.—*Evapotranspiration and precipitation data*

[All data based on records kept at Kaycee]

Month	Potential evapotranspiration			Average precipitation minus maximum potential evapotranspiration
	Maximum	Above 32° F.[1]	Above 28° F.[2]	
	Inches	*Inches*	*Inches*	*Inches*
January	0	0	0	+0. 40
February	0	0	0	+. 32
March	0	0	0	+. 61
April	1. 20	0	0	+. 36
May	2. 72	0. 09	1. 40	−. 75
June	3. 98	3. 98	3. 98	−1. 78
July	5. 30	5. 30	5. 30	−4. 29
August	4. 73	4. 73	4. 73	−4. 07
September	2. 81	1. 59	2. 44	−1. 72
October	1. 47	0	0	−. 65
November	0	0	0	+. 51
December	0	0	0	+. 35
Year	22. 21	15. 69	17. 85	−10. 71

[1] Calculated from the last 32° temperature in spring to the first in fall.

[2] Calculated from the last 28° temperature in spring to the first in fall.

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Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates such as crumbs, blocks, or prisms are called peds. Clods are aggregates produced by tillage or logging.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that the growth of most crop plants is poor from this cause.

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Channery soil. A soil that contains thin, flat fragments of sandstone, limestone, or schist, as much as 6 inches in length along the longer axis. A single piece is called a fragment.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonym: clay coating.

Cobblestone. A rounded or partly rounded fragment of rock, 3 to 10 inches in diameter.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material; tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Drainage class (natural). Drainage that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven different classes of natural soil drainage are recognized.

Excessively drained soils are commonly very porous and rapidly permeable and have a low water-holding capacity.

Somewhat excessively drained soils are also very permeable and are free from mottling throughout their profile.

Well-drained soils are nearly free from mottling and are commonly of intermediate texture.

Moderately well drained soils commonly have a slowly permeable layer in or immediately beneath the solum. They have uniform color in the A horizon and upper part of the B horizons and have mottling in the lower part of the B horizon and in the C horizon.

Somewhat poorly drained soils are wet for significant periods but not all the time, and some soils commonly have mottling at a depth below 6 to 16 inches.

Poorly drained soils are wet for long periods; they are light gray and generally mottled from the surface downward, but some have few or no mottles.

Very poorly drained soils are wet nearly all the time. They have a dark-gray or black surface layer and are gray or light gray, with or without mottling, in the deeper parts of the profile.

Gravelly soil material. From 15 to 50 percent of material by volume, consists of rounded or angular rock fragments that are not prominently flattened and are up to 3 inches in diameter.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Leaching. The removal of soluble materials from soils or other material by percolating water.

Mottling, soil. Irregularly marked with spots of different colors that vary in number and size. Mottling in soils usually indicates poor aeration and lack of drainage. Descriptive terms are as follows: Abundance—*few, common,* and *many;* size—*fine, medium,* and *coarse;* and contrast—*faint, distinct,* and *prominent.* The size measurements are these: *fine,* less than 5 millimeters (about 0.2 inch) in diameter along the greatest dimension; *medium,* ranging from 5 millimeters to 15 millimeters (about 0.2 to 0.6 inch) in diameter along the greatest dimension; and *coarse,* more than 15 millimeters (about 0.6 inch) in diameter along the greatest dimension.

Munsell notation. A system for designating color by degrees of the three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color with a hue of 10YR, a value of 6, and a chroma of 4.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Residuum. Unconsolidated, partly weathered mineral material that accumulates over disintegrating solid rock. Residual material is not soil but is frequently the material in which a soil has formed.

Runoff (hydraulics). The part of the precipitation upon a drainage area that is discharged from the area in stream channels. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil that contains soluble salts in amounts that impair growth of plants but that does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments that range from 0.05 to 2.0 millimeters in diameter. Most sand grains consist of quartz, but the sand may be of any mineral composition as a textural class soil that is 85 percent or more sand and not more than 10 percent clay.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slope classes. In this report, the degrees of slope are expressed thus:

	Percent
Nearly level	0 to 3.
Gently sloping, or undulating	3 to 6.
Sloping, or rolling	6 to 10.
Moderately steep, hilly	10 to 20.
Steep	20 to 40.
Very steep	More than 40.

Soil depth. The depth of the soil profile. The depth to which the roots of common plants penetrate; the depth to the underlying bedrock, hardpan, or other restrictive layer. The depth classes used in this survey are: Very shallow, less than 8 inches; shallow, 8 to 20 inches; moderately deep, 20 to 40 inches; deep, more than 40 inches.

Surface layer. A term used in nontechnical soil descriptions for one or more layers above the subsoil. Includes A horizon and part of B horizon; has no depth limit.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Variant, soil. A soil having properties sufficiently different from those of other known soils to suggest establishing a new soil series, but a soil of such limited known area that creation of a new series is not believed to be justified.

Water table. The highest part of the soil or underlying rock material that is wholly saturated with water. In some places an upper, or perched, water table may be separated from a lower one by a dry zone.

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GUIDE TO MAPPING UNITS

For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series to which the mapping unit belongs. In referring to a capability unit or range site, read the introduction to the section it is in for general information about its management. Other information is given in tables, as follows:

Acreage and extent, table 1, page 8.
Estimated yields, table 2, page 94.

Engineering uses of the soils, tables 4, 5, and 6, pages 104 through 139.

			Capability unit				Range site	
			Dryland		Irrigated			
Map symbol	Mapping unit	Page	Symbol	Page	Symbol	Page	Name	Page
Aa	Absted clay-------------------------	10	VIs-71	92	VIs-71	90	Clayey, 10 to 14 inch precipitation zone	96
AB	Absted-Bone complex-----------------	10	VIs-71	92	-----	--	--------	--
	Absted part---------------------	--	-----	--	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Bone part----------------------	--	-----	--	-----	--	Dense Clay, 10 to 14 inch precipitation zone	97
ADB	Absted-Wyarno complex, gently sloping---------------------------	10	VIs-71	92	-----	--	--------	--
	Absted part---------------------	--	-----	--	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Wyarno part--------------------	--	-----	--	-----	--	Clayey, 10 to 14 inch precipitation zone	
ADC	Absted-Wyarno complex, sloping------	10	VIe-71	92	-----	--	--------	--
	Absted part--------------------	--	-----	--	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Wyarno part--------------------	--	-----	--	-----	--	Clayey, 10 to 14 inch precipitation zone	96
	Bone part----------------------	--	-----	--	-----	--	Dense Clay, 10 to 14 inch precipitation zone	97
AL	Alluvial land-----------------------	11	VIe-15	92	-----	--	Sands, 10 to 14 inch precipitation zone	98
AM	Amsden-Decross association----------	11	VIe-2	91	-----	--	Loamy, 15 to 19 inch precipitation zone	100

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
AS	Ascalon-Julesburg association-------	12	VIe-5	92	-----	--	--------	--
	Ascalon part--------------------	--	-----	--	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Julesburg part------------------	--	-----	--	-----	--	Sandy, 10 to 14 inch precipitation zone	98
	Maysdorf part-------------------	--	-----	--	-----	--	Loamy, 10 to 14 inch precipitation zone	97
AU	Auzqui-Slocum association-----------	13	VIe-2	91	-----	--	--------	--
	Auzqui part---------------------	--	-----	--	-----	--	Loamy, 15 to 19 inch precipitation zone	100
	Slocum part---------------------	--	-----	--	-----	--	Subirrigated, 15 to 19 inch precipitation zone	101
BA	Badland-----------------------------	13	VIIIe-82	93	-----	--	--------	--
Bd	Bankard sand------------------------	14	VIe-15	92	IVs-15	89	Sands, 10 to 14 inch precipitation zone	98
Be	Barnum silt loam--------------------	15	IVe-3	91	IIe-3	87	Lowland, 10 to 14 inch precipitation zone	97
Bf	Barnum silt loam, sandy subsoil variant--------------------------	16	IVe-3	91	IIe-3	87	Lowland, 10 to 14 inch precipitation zone	97
BK	Barnum-Redbank association----------	15	-----	--	-----	--	--------	--
	Barnum part---------------------	--	IVe-3	91	-----	--	Lowland, 10 to 14 inch precipitation zone	97
	Redbank part--------------------	--	IVe-5	91	-----	--	Lowland, 10 to 14 inch precipitation zone	
BM	Bayerton-Tolman association---------	16	-----	--	-----	--	--------	--
	Bayerton part-------------------	--	VIe-2	91	-----	--	--------	--
	Tolman part---------------------	--	VIIe-14	93	-----	--	Shallow Loamy, 15 to 19 inch precipitation zone	101
	Rock land-----------------------	--	VIIIs-83	93	-----	--	--------	--

Map symbol	Mapping unit	Page	Capability unit Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
BN	Big Horn-Wolf association----------	18	IVe-2	91	-----	--	--------	--
	Big Horn part-----------------	--	-----	--	-----	--	Clayey, 10 to 14 inch precipitation zone	96
	Wolf part---------------------	--	-----	--	-----	--	Loamy, 10 to 14 inch precipitation zone	97
BoB	Briggsdale sandy loam, 0 to 6 percent slopes-------------------	19	IVe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
BoC	Briggsdale sandy loam, 6 to 10 percent slopes------------------	19	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
BRD	Briggsdale-Bidman complex, rolling---------------------------	19	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
BSD	Briggsdale-Lohsman complex, rolling-------------------------	20	VIe-2	91	-----	--	--------	--
	Briggsdale part---------------	--	-----	--	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Lohsman part------------------	--	-----	--	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Cadoma part-------------------	--	-----	--	-----	--	Dense Clay, 10 to 14 inch precipitation zone	97
BT	Briggsdale-Pugsley association-----	20	-----	--	-----	--	--------	--
	Briggsdale part---------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Pugsley part------------------	--	VIe-5	92	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Renohill part-----------------	--	VIe-1	91	-----	--	Clayey, 10 to 14 inch precipitation zone	96

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Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site: Name	Range site: Page
BU	Briggsdale-Renohill association-----	20	-----	--	-----	---	--------	--
	Briggsdale part-----------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Renohill part-------------------	--	VIe-1	91	-----	--	Clayey, 10 to 14 inch precipitation zone	96
BWD	Briggsdale-Worf association, rolling--------------------------	20	-----	--	-----	--	--------	--
	Briggsdale part-----------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Worf part-----------------------	--	VIIe-14	93	-----	--	Shallow Loamy, 10 to 14 inch precipitation zone	99
BWE	Briggsdale-Worf association, hilly--	20	-----	--	-----	--	--------	--
	Briggsdale part-----------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Worf part-----------------------	--	VIIe-14	93	-----	--	Shallow Loamy, 10 to 14 inch precipitation zone	99
CD	Cloud Peak-Dell association---------	23	-----	--	-----	--	--------	--
	Cloud Peak part-----------------	--	VIs-9	92	-----	--	--------	--
	Dell part-----------------------	--	VIe-2	91	-----	--	--------	--
CE	Colluvial land----------------------	23	VIIs-9	93	-----	--	--------	--
CnA	Connerton silt loam, 0 to 3 percent slopes----------------------------	23	IVe-3	91	IIe-3	87	Loamy, 10 to 14 inch precipitation zone	97
CnB	Connerton silt loam, 3 to 6 percent slopes--------------------	23	IVe-3	91	IIIe-3	88	Loamy, 10 to 14 inch precipitation zone	97
CnC	Connerton silt loam, 6 to 10 percent slopes--------------------	24	VIe-3	92	IVe-3	89	Loamy, 10 to 14 inch precipitation zone	97
CnD	Connerton silt loam, 10 to 30 percent slopes--------------------	24	VIe-3	92	-----	--	Loamy, 10 to 14 inch precipitation zone	97

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
Co	Connerton silt loam, wet------------	24	VIws-10	92	IVws-10	90	Saline Subirrigated, 10 to 14 inch precipitation zone	98
CR	Connerton-La Fonda association------	24	-----	--	-----	--	--------	--
	Connerton part------------------	--	VIe-2	92	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	La Fonda part-------------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
CS	Connerton-Spearfish association-----	24	-----	--	-----	--	--------	--
	Connerton part------------------	--	VIe-3	92	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Spearfish part------------------	--	VIIe-14	93	-----	--	Shallow Loamy, 10 to 14 inch precipitation zone	99
CT	Cragola-Ascalon association---------	25	-----	--	-----	--	--------	--
	Cragola part--------------------	--	VIIe-14	93	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
	Ascalon part--------------------	--	VIe-5	92	-----	--	Loamy, 10 to 14 inch precipitation zone	97
CU	Cragola-Shingle association---------	25	VIIe-14	93	-----	--	--------	--
	Cragola part--------------------	--	-----	--	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
	Shingle part--------------------	--	-----	--	-----	--	Shallow Loamy, 10 to 14 inch precipitation zone	99
CV	Cushman-Briggsdale association------	26	-----	--	-----	--	--------	--
	Cushman part--------------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Briggsdale part-----------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Renohill part-------------------	--	VIe-1	91	-----	--	Clayey, 10 to 14 inch precipitation zone	96

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
CW	Cushman-Embry association	26	-----	--	-----	--	--------	--
	Cushman part	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Embry part	--	VIe-5	92	-----	--	Sandy, 10 to 14 inch precipitation zone	98
	Julesburg part	--	VIe-5	92	-----	--	Sandy, 10 to 14 inch precipitation zone	98
CX	Cushman-Terry association	26	-----	--	-----	--	--------	--
	Cushman part	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Terry part	--	VIe-5	92	-----	--	Sandy, 10 to 14 inch precipitation zone	98
DE	Decross-Woosley association	28	-----	--	-----	--	--------	--
	Decross part	--	VIe-2	91	-----	--	Loamy, 15 to 19 inch precipitation zone	100
	Woosley part	--	VIe-2	91	-----	--	Loamy, 15 to 19 inch precipitation zone	100
	Nathrop part	--	VIs-9	92	-----	--	Coarse Upland, 15 to 19 inch precipitation zone	100
DRD	Devoe-Rock land complex, 10 to 30 percent slopes	29	VIIe-14	93	-----	--	--------	--
	Devoe part	--	-----	--	-----	--	Shallow Clayey, 15 to 19 inch precipitation zone	101
	Rock land	--	-----	--	-----	--	--------	--
FcA	Fort Collins loam, 0 to 3 percent slopes	31	IVe-2	91	IIe-2	87	Loamy, 10 to 14 inch precipitation zone	97
FcB	Fort Collins loam, 3 to 6 percent slopes	31	IVe-2	91	IIIe-2	88	Loamy, 10 to 14 inch precipitation zone	97

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
FO	Fort Collins-Ascalon association----	31	-----	--	-----	--	--------	--
	Fort Collins part---------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Ascalon part-------------------	--	VIe-5	92	-----	--	Loamy, 10 to 14 inch precipitation zone	97
FU	Fort Collins-Ulm association--------	31	IVe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
GA	Gateson-Embry association-----------	33	-----	--	-----	--	--------	--
	Gateson part--------------------	--	VIe-2	91	-----	--	--------	--
	Embry part----------------------	--	VIe-5	92	-----	--	Sandy, 10 to 14 inch precipitation zone	98
Gd	Glenberg fine sandy loam------------	34	IVe-5	91	IIe-5	88	Lowland, 10 to 14 inch precipitation zone	97
Ge	Glenberg fine sandy loam, sand substratum-----------------------	34	IVe-5	91	IIIs-5	89	Lowland, 10 to 14 inch precipitation zone	97
GG	Glenberg-Bankard association--------	34	-----	--	-----	--	--------	--
	Glenberg part------------------	--	VIe-5	91	-----	--	Lowland, 10 to 14 inch precipitation zone	97
	Bankard part-------------------	--	VIe-15	92	-----	--	Sands, 10 to 14 inch precipitation zone	98
GU	Gullied land------------------------	34	VIIIe-82	93	-----	--	--------	--
Ha	Harlan silt loam--------------------	35	IVe-2	91	IIIe-2	88	Loamy, 10 to 14 inch precipitation zone	97
HD	Harlan-Kirtley association----------	35	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
He	Haverson silt loam------------------	36	IVe-2	91	IIe-2	87	Lowland, 10 to 14 inch precipitation zone	97
Hf	Haverson silt loam, wet-------------	36	VIws-11	93	IVws-11	90	Saline Subirrigated, 10 to 14 inch precipitation zone	98

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
Hg	Haverson clay loam-----------------	36	IVe-2	91	IIs-16	88	Clayey Overflow, 10 to 14 inch precipitation zone	96
HH	Haverson-Glenberg association------	36	-----	--	------	--	--------	--
	Haverson part------------------	--	IVe-2	91	-----	--	Lowland, 10 to 14 inch precipitation zone	97
	Glenberg part------------------	--	IVe-5	92	-----	--	Lowland, 10 to 14 inch precipitation zone	97
HK	Haverson-Glenberg association, saline--------------------------	36	VIws-11	93	-----	--	Saline Subirrigated, 10 to 14 inch precipitation zone	98
Hm	Haverson silt loam, sandy subsoil variant------------------	37	IVe-2	91	IIe-2	87	Lowland, 10 to 14 inch precipitation zone	97
HN	Hazton-Burgess association---------	37	-----	--	-----	--	--------	--
	Hazton gravelly coarse sandy loam, 10 to 30 percent slopes-----------------------	--	VIIe-14	93	-----	--	Shallow Loamy, 15 to 19 inch precipitation zone	101
	Hazton gravelly coarse sandy loam, 30 to 40 percent slopes-----------------------	--	VIIe-14	93	-----	--	Very Shallow, 15 to 19 inch precipitation zone	101
	Burgess part-------------------	--	VIe-5	92	-----	--	Sandy, 15 to 19 inch precipitation zone	100
HoA	Heldt silty clay loam, 0 to 3 percent slopes-------------------	38	IVs-1	91	IIIs-1	88	Clayey, 10 to 14 inch precipitation zone	96
HoB	Heldt silty clay loam, 3 to 6 percent slopes-------------------	38	IVe-1	90	IIIe-1	88	Clayey, 10 to 14 inch precipitation zone	
HoC	Heldt silty clay loam, 6 to 10 percent slopes-------------------	38	VIe-1	91	IVe-1	89	Clayey, 10 to 14 inch precipitation zone	96

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
IN	Indart fine sandy loam------------	39	VIe-5	92	-----	--	--------	--
Ju	Julesburg fine sandy loam---------	40	IVe-5	91	IIIs-5	89	Sandy, 10 to 14 inch precipitation zone	98
KCC	Keyner complex, 3 to 10 percent slopes-------------------------	40	VIs-71	92	VIs-71	90	Loamy, 10 to 14 inch precipitation zone	97
KdA	Kim loam, 0 to 3 percent slopes----	41	IVe-2	91	IIe-2	87	Loamy, 10 to 14 inch precipitation zone	97
KdB	Kim loam, 3 to 6 percent slopes----	41	IVe-2	91	IIIe-2	88	Loamy, 10 to 14 inch precipitation zone	97
KdC	Kim loam, 6 to 10 percent slopes---	41	VIe-2	91	IVe-2	89	Loamy, 10 to 14 inch precipitation zone	97
Ke	Kim loam, wet---------------------	41	VIws-10	92	IVws-10	90	Saline Subirrigated, 10 to 14 inch precipitation zone	98
KH	Kim-Haverson association-----------	41	IVe-2	91	-----	--	--------	--
	Kim part----------------------	--	-----	--	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Haverson part-----------------	--	-----	--	-----	--	Overflow, 10 to 14 inch precipitation zone	98
KT	Kim-Travessilla association--------	42	-----	--	-----	--	--------	
	Kim part----------------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Travessilla part--------------	--	VIIe-14	93	-----	--	Shallow Sandy, 10 to 14 inch precipitation zone	99
KZB	Kim-Zigweid association, gently sloping------------------------	42	IVe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
KZD	Kim-Zigweid association, moderately steep----------------	42	IVe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
LA	La Fonda-Harlan association--------	43	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
LE	Leavitt-Passcreek association------	44	VIe-2	91	-----	--	Loamy, 15 to 19 inch precipitation zone	100

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
LmA	Limon silty clay, 0 to 3 percent slopes	44	IVs-1	91	IIIs-1	88	Clayey, 10 to 14 inch precipitation zone	96
LmB	Limon silty clay, 3 to 6 percent slopes	44	IVe-1	90	IIIe-1	88	Clayey, 10 to 14 inch precipitation zone	96
LmC	Limon silty clay, 6 to 10 percent slopes	45	VIe-1	91	IVe-1	89	Clayey, 10 to 14 inch precipitation zone	96
LnB	Limon silty clay, saline, 0 to 6 percent slopes	45	VIs-71	92	IVs-12	89	Saline Lowland, 10 to 14 inch precipitation zone	98
LnC	Limon silty clay, saline, 6 to 10 percent slopes	45	VIe-71	92	IVs-12	89	Saline Lowland, 10 to 14 inch precipitation zone	98
LO	Limon-Cadoma association	45	-----	--	-----	--	--------	--
	Limon part	--	VIe-1	91	-----	--	Clayey, 10 to 14 inch precipitation zone	96
	Cadoma part	--	VIe-71	92	-----	--	Dense Clay, 10 to 14 inch precipitation zone	97
	Wyarno part	--	IVe-1	90	-----	--	Clayey, 10 to 14 inch precipitation zone	96
LR	Limon-Gaynor association	45	-----	--	-----	--	--------	--
	Limon part	--	VIe-1	91	-----	--	Clayey, 10 to 14 inch precipitation zone	96
	Gaynor part	--	VIe-1	91	-----	--	Clayey, 10 to 14 inch precipitation zone	96
	Samsil part	--	VIIe-14	93	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
Ls	Lohmiller silty clay loam	46	IVs-1	91	IIIs-1	88	Clayey Overflow, 10 to 14 inch precipitation zone	96

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
LTD	Lohsman-Orella complex, hilly-------	46	VIe-71	92	-----	--	--------	--
	Lohsman part--------------------	--	-----	--	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Orella part---------------------	--	-----	--	-----	--	Dense Clay, 10 to 14 inch precipitation zone	97
	Absted part---------------------	--	-----	--	-----	--	Loamy, 10 to 14 inch precipitation zone	97
MdB	Maysdorf sandy loam, 0 to 6 percent slopes--------------------	48	IVe-5	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
MdC	Maysdorf sandy loam, 6 to 10 percent slopes--------------------	48	VIe-5	92	-----	--	Loamy, 10 to 14 inch precipitation zone	97
MF	Maysdorf association----------------	48	VIe-5	92	-----	--	Loamy, 10 to 14 inch precipitation zone	97
MG	Maysdorf-Garrett association--------	49	VIe-5	92	-----	--	Loamy, 10 to 14 inch precipitation zone	97
MP	Maysdorf-Pugsley association--------	49	VIe-5	92	-----	--	Loamy, 10 to 14 inch precipitation zone	97
MR	Maysdorf-Schooner association-------	49	-----	--	-----	--	--------	--
	Maysdorf part-------------------	--	VIe-5	92	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Schooner part-------------------	--	VIIe-14	93	-----	--	Shallow Sandy, 10 to 14 inch precipitation zone	99
MSD	Moret-Rencalson complex, hilly------	50	VIIe-14	93	-----	--	--------	--
	Moret part----------------------	--	-----	--	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
	Rencalson part------------------	--	-----	--	-----	--	Clayey, 10 to 14 inch precipitation zone	96

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
MTD	Moret-Rock land complex, hilly------	50	VIIe-14	93	-----	--	--------	--
	Moret part---------------------	--	-----	--	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
	Rock land----------------------	--	-----	--	-----	--	--------	--
MU	Moret-Kirtley association-----------	49	-----	--	-----	--	--------	--
	Moret part---------------------	--	VIIe-14	93	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
	Kirtley part-------------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
MV	Moret-Shirk association------------	50	-----	--	-----	--	--------	--
	Moret part---------------------	--	VIIe-14	93	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
	Shirk part---------------------	--	VIe-2	91	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
NP	Nathrop-Passcreek association-------	50	-----	--	-----	--	--------	--
	Nathrop part-------------------	--	VIs-9	92	-----	--	Coarse Upland, 15 to 19 inch precipitation zone	100
	Passcreek part-----------------	--	VIe-2	91	-----	--	Loamy, 15 to 19 inch precipitation zone	100
NS	Nathrop-Starley association---------	51	-----	--	-----	--	--------	--
	Nathrop part-------------------	--	VIs-9	92	-----	--	Coarse Upland, 15 to 19 inch precipitation zone	100
	Starley part-------------------	--	VIIe-14	93	-----	--	Shallow Loamy, 15 to 19 inch precipitation zone	101
NW	Nathrop-Woosley association---------	51	-----	--	-----	--	--------	--
	Nathrop part-------------------	--	VIs-9	92	------	--	Coarse Upland, 15 to 19 inch precipitation zone	100
	Woosley part-------------------	--	VIe-2	91	-----	--	Loamy, 15 to 19 inch precipitation zone	100

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
OK	Otero-Kim association	52	-----	---	-----	--	--------	--
	Otero part	--	VIe-5	92	-----	--	Sandy, 10 to 14 inch precipitation zone	98
	Kim part	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Glenberg part	--	IVe-5	91	-----	--	Overflow, 10 to 14 inch precipitation zone	98
PA	Passcreek-Sublette-Slipman association	53	-----	--	-----	--	--------	--
	Passcreek part	--	VIe-2	91	-----	--	Loamy, 15 to 19 inch precipitation zone	100
	Sublette part	--	VIe-5	92	-----	--	Sandy, 15 to 19 inch precipitation zone	100
	Slipman part	--	VIe-5	92	-----	--	--------	--
	Sunup part	--	VIIe-14	93	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
Pc	Petrie silty clay	54	VIs-71	92	VIs-71	90	Saline Lowland, 10 to 14 inch precipitation zone	98
PE	Petrie-Bone complex	54	VIs-71	92	-----	--	--------	--
	Petrie part	--	-----	--	-----	--	Saline Lowland, 10 to 14 inch precipitation zone	98
	Bone part	--	-----	--	-----	--	Dense Clay, 10 to 14 inch precipitation zone	97
PG	Pineguest-Mathers association	55	VIe-5	92	-----	--	--------	--

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
PKD	Pokeman-Gystrum-Rekop complex, hilly	55	VIe-2	91	-----	--	--------	--
	Pokeman part	--	-----	--	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Gystrum part	--	-----	--	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Rekop part	--	-----	--	-----	--	Shallow Loamy, 10 to 14 inch precipitation zone	99
PM	Poker-Bachus-Splitro association	56	-----	--	-----	--	--------	--
	Poker part	--	VIe-5	92	-----	--	Sandy, 15 to 19 inch precipitation zone	100
	Bachus part	--	VIe-2	91	-----	--	Loamy, 15 to 19 inch precipitation zone	100
	Splitro part	--	VIIe-14	93	-----	--	Shallow Loamy, 15 to 19 inch precipitation zone	101
PS	Potts-Kim association	57	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
PT	Potts-Kirtley association	57	-----	--	-----	--	--------	--
	Potts part	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Kirtley part	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Shingle part	--	VIIe-14	93	-----	--	Shallow Loamy, 10 to 14 inch precipitation zone	99
PU	Pugsley-Gateson association	58	-----	--	-----	--	--------	--
	Pugsley part	--	VIe-5	92	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Gateson part	--	VIe-2	91	-----	--	--------	--
	Embry part	--	VIe-5	92	-----	--	Sandy, 10 to 14 inch precipitation zone	98

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
PXD	Pugsley-Southfork complex, hilly----	58	VIIe-14	93	-----	--	--------	--
	Pugsley part--------------------	--	-----	--	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Southfork part------------------	--	-----	--	-----	--	Shallow Sandy, 10 to 14 inch precipitation zone	99
	Tassel part---------------------	--	-----	--	-----	--	Shallow Sandy, 10 to 14 inch precipitation zone	99
RAD	Razor-Gaynor-Samsil complex, hilly----------------------------	59	VIe-1	91	-----	--	--------	--
	Razor part----------------------	--	-----	--	-----	--	Clayey, 10 to 14 inch precipitation zone	96
	Gaynor part---------------------	--	-----	--	-----	--	Clayey, 10 to 14 inch precipitation zone	96
	Samsil part---------------------	--	-----	--	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
RcB	Renohill clay loam, 0 to 6 percent slopes--------------------	61	IVe-1	90	-----	--	Clayey, 10 to 14 inch precipitation zone	96
RcC	Renohill clay loam, 6 to 14 percent slopes--------------------	61	VIe-1	91	-----	--	Clayey, 10 to 14 inch precipitation zone	96

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
RD	Renohill-Danko association---------	61	-----	--	-----	--	--------	--
	Renohill part------------------	--	VIe-1	91	-----	--	Clayey, 10 to 14 inch precipitation zone	96
	Danko part---------------------	--	VIIe-14	93	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
	Gaynor part--------------------	--	VIe-1	91	-----	--	Clayey, 10 to 14 inch precipitation zone	96
	Samsil part--------------------	--	VIIe-14	93	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
REC	Renohill-Razor association, undulating----------------------	61	-----	--	-----	--	--------	--
	Renohill part------------------	--	IVe-1	90	-----	--	Clayey, 10 to 14 inch precipitation zone	96
	Razor part---------------------	--	IVe-1	90	-----	--	Clayey, 10 to 14 inch precipitation zone	96
	Samsil part--------------------	--	VIIe-14	93	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
RED	Renohill-Razor association, rolling--	61	-----	--	-----	--	--------	--
	Renohill part------------------	--	VIe-1	91	-----	--	Clayey, 10 to 14 inch precipitation zone	96
	Razor part---------------------	--	VIe-1	91	-----	--	Clayey, 10 to 14 inch precipitation zone	96
	Samsil part--------------------	--	VIIe-14	93	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
RhB	Rhoame silty clay, 0 to 6 percent slopes-------------------	62	IVe-1	90	IIIe-1	88	Clayey, 10 to 14 inch precipitation zone	96
RhC	Rhoame silty clay, 6 to 10 percent slopes-------------------	62	VIe-1	91	IVe-1	89	Clayey, 10 to 14 inch precipitation zone	96

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
RM	Rhoame complex	62	IVe-1	90	------	--	Clayey, 10 to 14 inch precipitation zone	96
RND	Rhoame-Moret complex, hilly	62	VIIe-14	93	-----	--	--------	--
	Rhoame part	--	-----	--	-----	--	Clayey, 10 to 14 inch precipitation zone	96
	Moret part	--	-----	--	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
RO	Rock land	62	VIIIs-83	93	-----	--	--------	--
SA	Saline, wet land	63	VIs-71	92	VIs-71	90	Saline Subirrigated, 10 to 14 inch precipitation zone	98
SCD	Samsil-Gaynor-Cadoma complex, rolling	63	VIIe-14	93	-----	--	--------	--
	Samsil part	--	-----	--	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
	Gaynor part	--	-----	--	-----	--	Clayey, 10 to 14 inch precipitation zone	96
	Cadoma part	--	-----	--	-----	--	Dense Clay, 10 to 14 inch precipitation zone	97
	Razor part	--	-----	--	-----	--	Clayey, 10 to 14 inch precipitation zone	96
SDE	Samsil-Shale outcrop complex, steep	63	VIIe-14	93	-----	--	--------	--
	Samsil silty clay, 10 to 30 percent slopes	--	-----	--	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
	Samsil silty clay, 30 to 40 percent slopes	--	-----	--	-----	--	Very Shallow, 10 to 14 inch precipitation zone	99
	Shale outcrop	--	-----	--	-----	--	--------	--

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
SE	Samsil-Renohill association--------	63	-----	--	-----	--	--------	--
	Samsil part--------------------	--	VIIe-14	93	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
	Renohill part------------------	--	VIe-1	91	-----	--	Clayey, 10 to 14 inch precipitation zone	96
	Wyarno part--------------------	--	VIe-1	91	-----	--	Clayey, 10 to 14 inch precipitation zone	96
SF	Sanford-Wetterhorn association-----	64	-----	--	-----	--	--------	--
	Sanford part-------------------	--	VIe-5	92	-----	--	--------	--
	Wetterhorn part----------------	--	VIe-2	91	-----	--	--------	--
SH	Shale outcrop---------------------	65	VIIIs-83	93	-----	--	--------	--
SK	Shale rock land-------------------	65	VIIIs-83	93	-----	--	--------	--
Sm	Shingle clay loam-----------------	66	VIIe-14	93	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
SNa	Shingle-Briggsdale association-----	66	-----	--	-----	--	--------	--
	Shingle part-------------------	--	VIIe-14	93	-----	--	Shallow Loamy, 10 to 14 inch precipitation zone	99
	Briggsdale part----------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
SNb	Shingle-Cushman association--------	66	-----	--	-----	--	--------	--
	Shingle part-------------------	--	VIIe-14	93	-----	--	Shallow Loamy, 10 to 14 inch precipitation zone	99
	Cushman part-------------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	
SNc	Shingle-Kim association------------	66	-----	--	-----	--	--------	--
	Shingle part-------------------	--	VIIe-14	93	-----	--	Shallow Loamy, 10 to 14 inch precipitation zone	99
	Kim part-----------------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Zigweid part-------------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Name	Page
SNd	Shingle-Kim association, valleys----	66	-----	--	-----	--	--------	--
	Shingle part--------------------	--	VIIe-14	93	-----	--	Shallow Loamy, 10 to 14 inch preci- pitation zone	99
	Kim part------------------------	--	VIe-2	91	-----	--	Overflow, 10 to 14 inch precipitation zone	98
	Samsil part---------------------	--	VIIe-14	93	-----	--	Shallow Clayey, 10 to 14 inch precipi- tation zone	99
SNe	Shingle-Tassel association----------	67	-----	--	-----	--	--------	--
	Shingle loam, 10 to 30 percent slopes------------------------	--	VIIe-14	93	-----	--	Shallow Loamy, 10 to 14 inch precipi- tation zone	99
	Shingle loam, 30 to 40 percent slopes------------------------	--	VIIe-14	93	-----	--	Very Shallow, 10 to 14 inch precipitation zone	99
	Tassel sandy loam, 15 to 30 percent slopes----------------	--	VIIe-14	93	-----	--	Shallow Sandy, 10 to 14 inch precipi- tation zone	99
	Tassel sandy loam, 30 to 40 percent slopes----------------	--	VIIe-14	93	-----	--	Very Shallow, 10 to 14 inch precipi- tation zone	99
	Kim part------------------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch pre- cipitation zone	97
SNf	Shingle-Worf association------------	67	VIIe-14	93	-----	--	Shallow Loamy, 10 to 14 inch precipi- tation zone	99

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
SOE	Simmont-Rock outcrop complex, steep	68	VIIs-9	93	-----	--	--------	--
	Simmont part	--	-----	--	-----	--	--------	--
	Rock outcrop	--	-----	--	-----	--	--------	--
SPE	Spearfish-Shale outcrop complex, steep	70	VIIe-14	93	-----	--	--------	--
	Spearfish very fine sandy loam, 10 to 30 percent slopes	--	-----	--	-----	--	Shallow Loamy, 10 to 14 inch precipitation zone	99
	Spearfish very fine sandy loam, 30 to 40 percent slopes	--	-----	--	-----	--	Very Shallow, 10 to 14 inch precipitation zone	99
	Shale outcrop	--	-----	--	-----	--	--------	--
SRE	Starley-Rock outcrop complex, steep	71	VIIe-14	93	-----	--	--------	--
	Starley gravelly loam, 10 to 30 percent slopes	--	-----	--	-----	--	Shallow Loamy, 15 to 19 inch precipitation zone	101
	Starley gravelly loam, 30 to 40 percent slopes	--	-----	--	-----	--	Very Shallow, 15 to 19 inch precipitation zone	101
	Rock outcrop	--	-----	--	-----	--	--------	--
SsA	Stoneham loam, 0 to 3 percent slopes	72	IVe-2	91	IIe-2	87	Loamy, 10 to 14 inch precipitation zone	97
SsB	Stoneham loam, 3 to 6 percent slopes	72	IVe-2	91	IIIe-2	88	Loamy, 10 to 14 inch precipitation zone	97
SsC	Stoneham loam, 6 to 10 percent slopes	72	VIe-2	91	IVe-2	89	Loamy, 10 to 14 inch precipitation zone	97
STa	Stoneham-Absted complex	72	IVe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
STb	Stoneham-Ascalon association-------	72	-----	--	-----	--	--------	--
	Stoneham part------------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Ascalon part-------------------	--	IVe-5	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
STc	Stoneham-Cragola association-------	72	-----	--	-----	--	--------	--
	Stoneham part------------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Cragola part-------------------	--	VIIe-14	93	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
	Wolf part----------------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
STd	Stoneham-Cushman association-------	73	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
STe	Stoneham-Fort Collins association--	73	IVe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
STf	Stoneham-Kim association-----------	73	-----	--	-----	--	--------	--
	Stoneham part------------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Kim part-----------------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Shingle part-------------------	--	VIIe-14	93	-----	--	Shallow Loamy, 10 to 14 inch precipitation zone	99
STg	Stoneham-Zigweid association-------	73	IVe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
SU	Stubbs-Turk association------------	74	-----	--	-----	--	--------	--
	Stubbs part--------------------	--	VIe-2	91	-----	--	Loamy, 15 to 19 inch precipitation zone	100
	Turk part----------------------	--	VIe-1	91	-----	--	Clayey, 15 to 19 inch precipitation zone	100

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
SVE	Sunup-Rock outcrop complex, steep---	75	VIIe-14	93	-----	--	--------	--
	Sunup part----------------------	--	-----	--	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
	Rock outcrop--------------------	--	-----	--	-----	--	--------	--
SW	Sunup-Carnero association-----------	75	-----	--	-----	--	--------	--
	Sunup part----------------------	--	VIIe-14	93	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
	Carnero part--------------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
TE	Terry-Tassel association------------	76	-----	--	-----	--	--------	--
	Terry part----------------------	--	VIe-5	92	-----	--	Sandy, 10 to 14 inch precipitation zone	98
	Tassel part---------------------	--	VIIe-14	93	-----	--	Shallow Sandy, 10 to 14 inch precipitation zone	99
	Shingle part--------------------	--	VIIe-14	93	-----	--	Shallow Loamy, 10 to 14 inch precipitation zone	99
TRE	Travessilla-Rock outcrop complex, steep-----------------------------	77	VIIe-14	93	-----	--	--------	--
	Travessilla part----------------	--	-----	--	-----	--	Shallow Sandy, 10 to 14 inch precipitation zone	99
	Rock outcrop--------------------	--	-----	--	-----	--	--------	--
TS	Tripit-Devoe association------------	78	-----	--	-----	--	--------	--
	Tripit part---------------------	--	VIe-2	91	-----	--	Loamy, 15 to 19 inch precipitation zone	100
	Devoe part----------------------	--	VIIe-14	93	-----	--	Shallow Clayey, 15 to 19 inch precipitation zone	101
	Amsden part---------------------	--	VIe-2	91	-----	--	Loamy, 15 to 19 inch precipitation zone	100

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
TT	Tripit-Sawcreek association--------	78	-----	--	-----	--	--------	--
	Tripit part--------------------	--	VIe-2	91	-----	--	Loamy, 15 to 19 inch precipitation zone	100
	Sawcreek part------------------	--	VIe-5	92	-----	--	Sandy, 15 to 19 inch precipitation zone	100
TU	Turk-Lymanson-Jenkinson association---------------------	79	-----	--	-----	--	--------	--
	Turk part----------------------	--	VIe-1	91	-----	--	Clayey, 15 to 19 inch precipitation zone	100
	Lymanson part------------------	--	VIe-2	91	-----	--	Loamy, 15 to 19 inch precipitation zone	100
	Jenkinson part-----------------	--	VIIe-14	93	-----	--	Shallow Clayey, 15 to 19 inch precipitation zone	101
U1A	Ulm loam, 0 to 3 percent slopes----	79	IVe-2	91	IIe-2	87	Loamy, 10 to 14 inch precipitation zone	97
U1B	Ulm loam, 3 to 6 percent slopes----	80	IVe-2	91	IIIe-2	88	Loamy, 10 to 14 inch precipitation zone	97
UM	Ulm-Cushman association------------	80	-----	--	-----	--	--------	--
	Ulm part-----------------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Cushman part-------------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Maysdorf part------------------	--	VIe-5	92	-----	--	Loamy, 10 to 14 inch precipitation zone	97
UW	Ulm-Wyarno association-------------	80	-----	--	-----	--	--------	--
	Ulm part-----------------------	--	IVe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Wyarno part--------------------	--	IVe-1	90	-----	--	Clayey, 10 to 14 inch precipitation zone	96

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
VC	Valent-Cushman association---------	80	-----	--	-----	--	--------	--
	Valent part--------------------	--	VIIe-15	93	-----	--	Sands, 10 to 14 inch precipitation zone	98
	Cushman part-------------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Tassel part--------------------	--	VIIe-14	93	-----	--	Shallow Sandy, 10 to 14 inch precipitation zone	99
WC	Wolf-Cragola association-----------	82	-----	--	-----	--	--------	--
	Wolf part----------------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
	Cragola part-------------------	--	VIIe-14	93	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
WE	Wormser-Englewood association------	83	VIe-1	91	-----	--	Clayey, 10 to 14 inch precipitation zone	96
WM	Wormser-Shirk association----------	84	-----	--	-----	--	--------	--
	Wormser part-------------------	--	VIe-1	91	-----	--	Clayey, 10 to 14 inch precipitation zone	96
	Shirk part---------------------	--	VIe-2	91	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
	Moret part---------------------	--	VIIe-14	93	-----	--	Shallow Clayey, 10 to 14 inch precipitation zone	99
WnA	Wyarno clay loam, 0 to 3 percent slopes-------------------	84	IVs-1	91	IIs-16	88	Clayey, 10 to 14 inch precipitation zone	96
WnB	Wyarno clay loam, 3 to 6 percent slopes---------------------------	84	IVe-1	90	IIIe-1	88	Clayey, 10 to 14 inch precipitation zone	96

Map symbol	Mapping unit	Page	Capability unit: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
WO	Wyarno-Limon association----------	84	IVe-1	90	-----	--	Clayey, 10 to 14 inch precipitation zone	96
WY	Wyarno-Stoneham association--------	85	-----	--	-----	--	--------	--
	Wyarno part--------------------	--	VIe-1	91	-----	--	Clayey, 10 to 14 inch precipitation zone	96
	Stoneham part------------------	--	VIe-2	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97
ZgA	Zigweid loam, 0 to 3 percent slopes---------------------------	85	IVe-2	91	IIe-2	87	Loamy, 10 to 14 inch precipitation zone	97
ZgB	Zigweid loam, 3 to 6 percent slopes---------------------------	85	IVe-2	91	IIIe-2	88	Loamy, 10 to 14 inch precipitation zone	97
ZKD	Zigweid-Keyner complex, hilly------	86	VIe-1	91	-----	--	Loamy, 10 to 14 inch precipitation zone	97

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

WYOMING AGRICULTURAL EXPERIMENT STATION

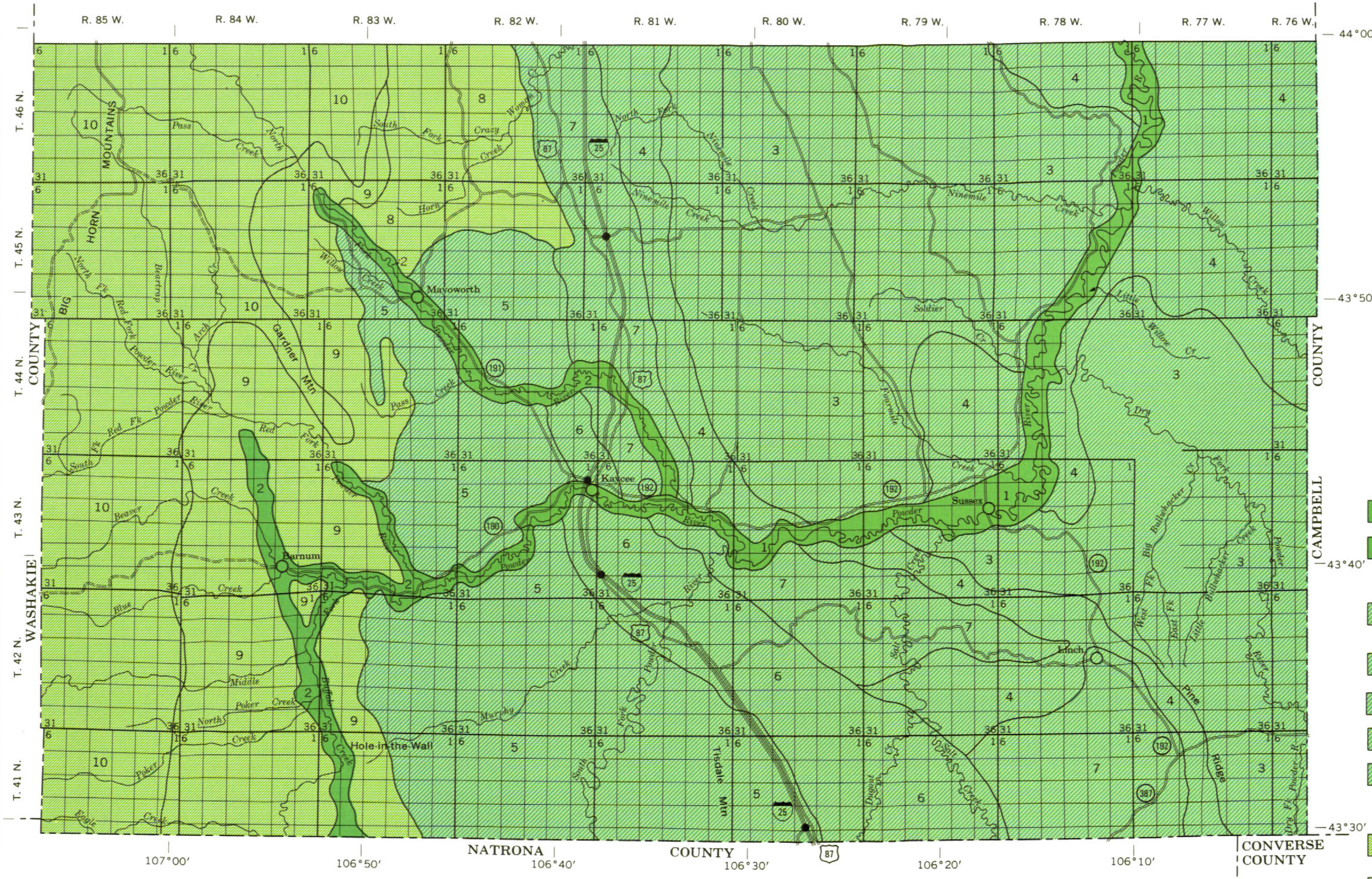
GENERAL SOIL MAP

JOHNSON COUNTY, WYOMING
SOUTHERN PART

Scale 1:316,800

1 0 1 2 3 4 5 Miles

N



SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL ASSOCIATIONS*

NEARLY LEVEL TO MODERATELY STEEP SOILS ON FLOOD PLAINS AND ALLUVIAL FANS

1 Stoneham-Haverson-Glenberg association: Deep sandy loams, fine sandy loams, loams, and silt loams

2 Connerton-Barnum-Redbank association: Deep fine sandy loams, very fine sandy loams, loams, clay loams, and silt loams

NEARLY LEVEL TO STEEP SOILS ON UPLANDS

3 Briggsdale-Renohill-Cushman association: Moderately deep, nearly level to moderately steep sandy loams, fine sandy loams, and clay loams

4 Samsil-Shingle-Rock land association: Shallow, gently sloping to steep silty clays, loams, and clay loams, and steep and very steep Rock land

5 Shale outcrop-Moret association: Sloping to steep Shale outcrop and shallow, moderately steep or steep clay loams

6 Samsil-Gaynor-Shale outcrop association: Moderately deep and shallow, sloping to steep silty clays and Shale outcrop

7 Tassel-Cushman-Stoneham association: Shallow to deep, sloping to steep sandy loams, fine sandy loams, and loams

NEARLY LEVEL TO STEEP SOILS ON HIGH TERRACES, FOOTHILLS, AND MOUNTAINS

8 Cragola-Wolf-Big Horn association: Shallow to deep, nearly level to steep loams and very gravelly loams; on high terraces

9 Sunup-Spearfish-Rock outcrop association: Shallow, moderately steep and steep very fine sandy loams and channery clay loams and Rock outcrop; on foothills

10 Nathrop-Starley-Woosley association: Moderately deep and shallow, sloping to steep loams, gravelly loams, and stony loams

* The terms for texture used in the descriptive heading of the associations apply to the surface layer of the major soils.

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

Compiled 1973

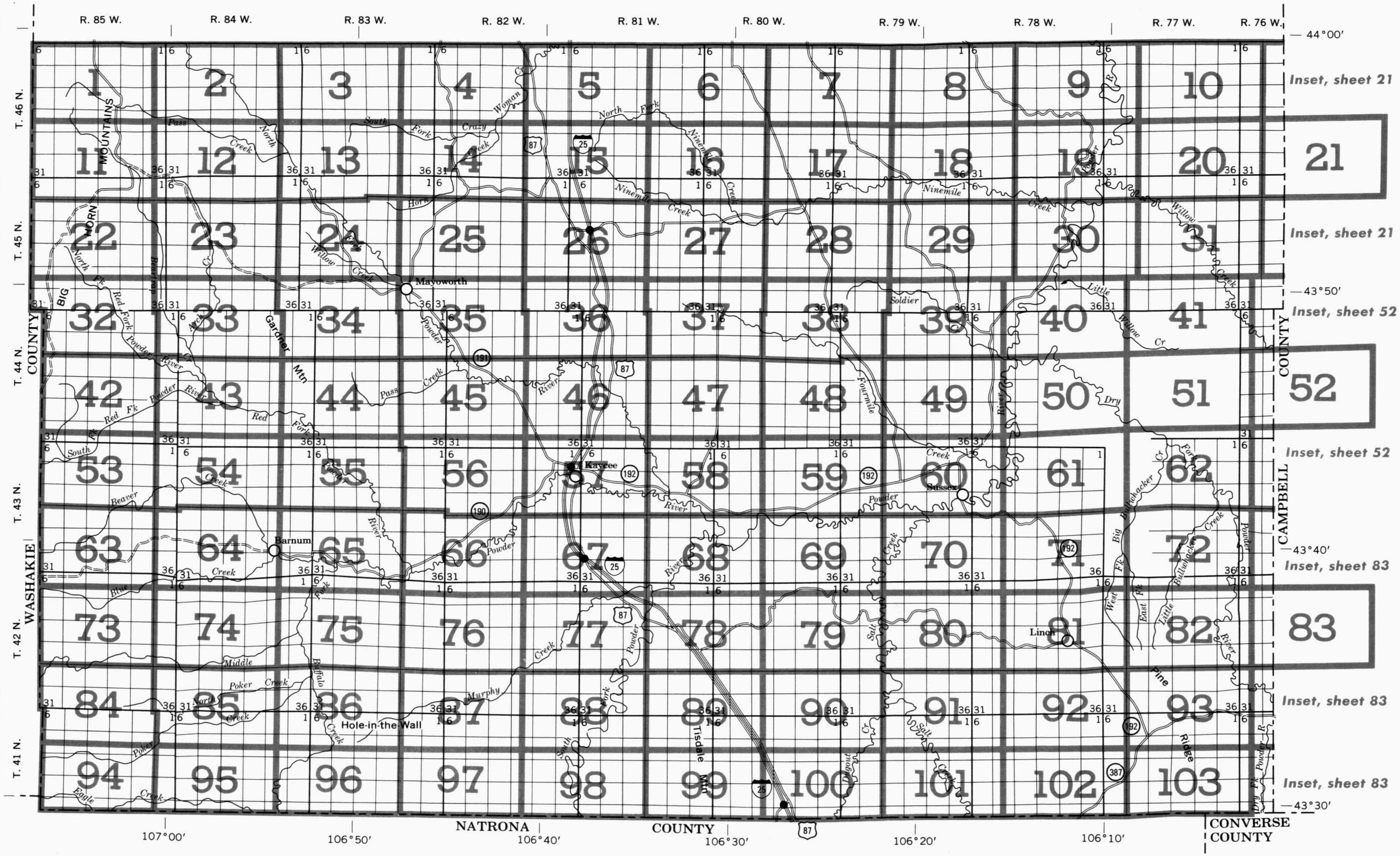
INDEX TO MAP SHEETS

JOHNSON COUNTY, WYOMING
SOUTHERN PART

Scale 1:316,800

1 0 1 2 3 4 5 Miles

N



SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

SOIL LEGEND

The first capital letter is the initial one of the soil name. The next letter is a capital if the mapping unit is one of the low intensity survey; it is a small letter if the mapping unit is one of the high intensity survey. The last letter, a capital A, B, C, D, or E, indicates the slope. Most symbols without a slope letter are those of soils and land types that have a considerable range of slope, but some are for nearly level soils.

SYMBOL Low Intensity	SYMBOL High Intensity	NAME
-	Aa	Absted clay
AB	-	Absted-Bone complex
ADB	-	Absted-Wyarno complex, gently sloping
ADC	-	Absted-Wyarno complex, sloping
AL	-	Alluvial land
AM	-	Amsden-Decross association
AS	-	Ascalon-Julesburg association
AU	-	Auzqui-Slocum association
BA	-	Badland
-	Bd	Bankard sand
-	Be	Barnum silt loam
-	Bf	Barnum silt loam, sandy subsoil variant
BK	-	Barnum-Redbank association
BM	-	Bayerton-Tolman association
BN	-	Big Horn-Wolf association
-	BoB	Briggsdale sandy loam, 0 to 6 percent slopes
-	BoC	Briggsdale sandy loam, 6 to 10 percent slopes
BRD	-	Briggsdale-Bidman complex, rolling
BSD	-	Briggsdale-Lohsman complex, rolling
BT	-	Briggsdale-Pugsley association
BU	-	Briggsdale-Renohill association
BWD	-	Briggsdale-Worf association, rolling
BWE	-	Briggsdale-Worf association, hilly
CD	-	Cloud Peak-Dell association
CE	-	Colluvial land
-	CnA	Connerton silt loam, 0 to 3 percent slopes
-	CnB	Connerton silt loam, 3 to 6 percent slopes
-	CnC	Connerton silt loam, 6 to 10 percent slopes
-	CnD	Connerton silt loam, 10 to 30 percent slopes
-	Co	Connerton silt loam, wet
CR	-	Connerton-La Fonda association
CS	-	Connerton-Spearfish association
CT	-	Cragola-Ascalon association
CU	-	Cragola-Shingle association
CV	-	Cushman-Briggsdale association
CW	-	Cushman-Embry association
CX	-	Cushman-Terry association
DE	-	Decross-Woosley association
DRD	-	Devoe-Rock land complex, 10 to 30 percent slopes
-	FcA	Fort Collins loam, 0 to 3 percent slopes
-	FcB	Fort Collins loam, 3 to 6 percent slopes
FO	-	Fort Collins-Ascalon association
FU	-	Fort Collins-Ulm association
GA	-	Gateson-Embry association
-	Gd	Glenberg fine sandy loam
-	Ge	Glenberg fine sandy loam, sand substratum
GG	-	Glenberg-Bankard association
GU	-	Gullied land
-	Ha	Harlan silt loam
HD	-	Harlan-Kirtley association
-	He	Haverson silt loam
-	Hf	Haverson silt loam, wet
-	Hg	Haverson clay loam
HH	-	Haverson-Glenberg association
HK	-	Haverson-Glenberg association, saline
-	Hm	Haverson silt loam, sandy subsoil variant
HN	-	Hazton-Burgess association

SYMBOL Low Intensity	SYMBOL High Intensity	NAME
-	HoA	Heldt silty clay loam, 0 to 3 percent slopes
-	HoB	Heldt silty clay loam, 3 to 6 percent slopes
-	HoC	Heldt silty clay loam, 6 to 10 percent slopes
IN	-	Indart fine sandy loam
-	Ju	Julesburg fine sandy loam
KCC	-	Keyner complex, 3 to 10 percent slopes
-	KdA	Kim loam, 0 to 3 percent slopes
-	KdB	Kim loam, 3 to 6 percent slopes
-	KdC	Kim loam, 6 to 10 percent slopes
-	Ke	Kim loam, wet
KH	-	Kim-Haverson association
KT	-	Kim-Travessilla association
KZB	-	Kim-Zigweid association, gently sloping
KZD	-	Kim-Zigweid association, moderately steep
LA	-	La Fonda-Harlan association
LE	-	Leavitt-Passcreek association
-	LmA	Limon silty clay, 0 to 3 percent slopes
-	LmB	Limon silty clay, 3 to 6 percent slopes
-	LmC	Limon silty clay, 6 to 10 percent slopes
-	LnB	Limon silty clay, saline, 0 to 6 percent slopes
-	LnC	Limon silty clay, saline, 6 to 10 percent slopes
LO	-	Limon-Cadoma association
LR	-	Limon-Gaynor association
-	Ls	Lohmiller silty clay loam
LTD	-	Lohsman-Orella complex, hilly
-	MdB	Maysdorf sandy loam, 0 to 6 percent slopes
-	MdC	Maysdorf sandy loam, 6 to 10 percent slopes
MF	-	Maysdorf association
MG	-	Maysdorf-Garrett association
MP	-	Maysdorf-Pugsley association
MR	-	Maysdorf-Schooner association
MSD	-	Moret-Rencalson complex, hilly
MTD	-	Moret-Rock land complex, hilly
MU	-	Moret-Kirtley association
MV	-	Moret-Shirk association
NP	-	Nathrop-Passcreek association
NS	-	Nathrop-Starley association
NW	-	Nathrop-Woosley association
OK	-	Otero-Kim association
PA	-	Passcreek-Sublette-Slipman association
-	Pc	Petrie silty clay
PE	-	Petrie-Bone complex
PG	-	Pineguest-Mathers association
PKD	-	Pokeman-Gystrum-Rekop complex, hilly
PM	-	Poker-Bachus-Splitro association
PS	-	Potts-Kim association
PT	-	Potts-Kirtley association
PU	-	Pugsley-Gateson association
PXD	-	Pugsley-Southfork complex, hilly
RAD	-	Razor-Gaynor-Samsil complex, hilly
-	RcB	Renohill clay loam, 0 to 6 percent slopes
-	RcC	Renohill clay loam, 6 to 14 percent slopes
RD	-	Renohill-Danko association
REC	-	Renohill-Razor association, undulating
RED	-	Renohill-Razor association, rolling

SYMBOL Low Intensity	SYMBOL High Intensity	NAME
-	RhB	Rhoame silty clay, 0 to 6 percent slopes
-	RhC	Rhoame silty clay, 6 to 10 percent slopes
RM	-	Rhoame complex
RND	-	Rhoame-Moret complex, hilly
RO	-	Rock land
SA	-	Saline, wet land
SCD	-	Samsil-Gaynor-Cadoma complex, rolling
SDE	-	Samsil-Shale outcrop complex, steep
SE	-	Samsil-Renohill association
SF	-	Sanford-Wetterhorn association
SH	-	Shale outcrop
SK	-	Shale rock land
-	Sm	Shingle clay loam
SNa	-	Shingle-Briggsdale association
SNb	-	Shingle-Cushman association
SNc	-	Shingle-Kim association
SNd	-	Shingle-Kim association, valleys
SNe	-	Shingle-Tassel association
SNf	-	Shingle-Worf association
SOE	-	Simmont-Rock outcrop complex, steep
SPE	-	Spearfish-Shale outcrop complex, steep
SRE	-	Starley-Rock outcrop complex, steep
-	SsA	Stoneham loam, 0 to 3 percent slopes
-	SsB	Stoneham loam, 3 to 6 percent slopes
-	SsC	Stoneham loam, 6 to 10 percent slopes
STa	-	Stoneham-Absted complex
STb	-	Stoneham-Ascalon association
STc	-	Stoneham-Cragola association
STd	-	Stoneham-Cushman association
STe	-	Stoneham-Fort Collins association
STf	-	Stoneham-Kim association
STg	-	Stoneham-Zigweid association
SU	-	Stubbs-Turk association
SVE	-	Sunup-Rock outcrop complex, steep
SW	-	Sunup-Carnero association
TE	-	Terry-Tassel association
TRE	-	Travessilla-Rock outcrop complex, steep
TS	-	Tripit-Devoe association
TT	-	Tripit-Sawcreek association
TU	-	Turk-Lymanson-Jenkinson association
-	UlA	Ulm loam, 0 to 3 percent slopes
-	UlB	Ulm loam, 3 to 6 percent slopes
UM	-	Ulm-Cushman association
UW	-	Ulm-Wyarno association
VC	-	Valent-Cushman association
WC	-	Wolf-Cragola association
WE	-	Wormser-Englewood association
WM	-	Wormser-Shirk association
-	WnA	Wyarno clay loam, 0 to 3 percent slopes
-	WnB	Wyarno clay loam, 3 to 6 percent slopes
WO	-	Wyarno-Limon association
WY	-	Wyarno-Stoneham association
-	ZgA	Zigweid loam, 0 to 3 percent slopes
-	ZgB	Zigweid loam, 3 to 6 percent slopes
ZKD	-	Zigweid-Keyner complex, hilly

JOHNSON COUNTY, WYOMING, SOUTHERN PART

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads

- Divided
- Good motor
- Poor motor
- Trail

Highway markers

- National Interstate
- U. S.
- State or county

Railroads

- Single track
- Multiple track
- Abandoned

Bridges and crossings

- Road
- Trail
- Railroad
- Ferry — FY
- Ford — FORD
- Grade
- R. R. over
- R. R. under

Buildings

- School
- Church

Mine and quarry

Gravel pit — G.P.

Power line

Pipeline

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Corral

Located object

BOUNDARIES

- National or state
- County
- Minor civil division
- Reservation
- Soil survey
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

Streams, double-line

- Perennial
- Intermittent

Streams, single-line

- Perennial
- Intermittent
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Unclassified

Canals and ditches

Lakes and ponds

- Perennial — water, w
- Intermittent — int

Spring

Marsh or swamp

Wet spot

Drainage end or alluvial fan

RELIEF

Escarpments

- Bedrock
- Other

Short steep slope

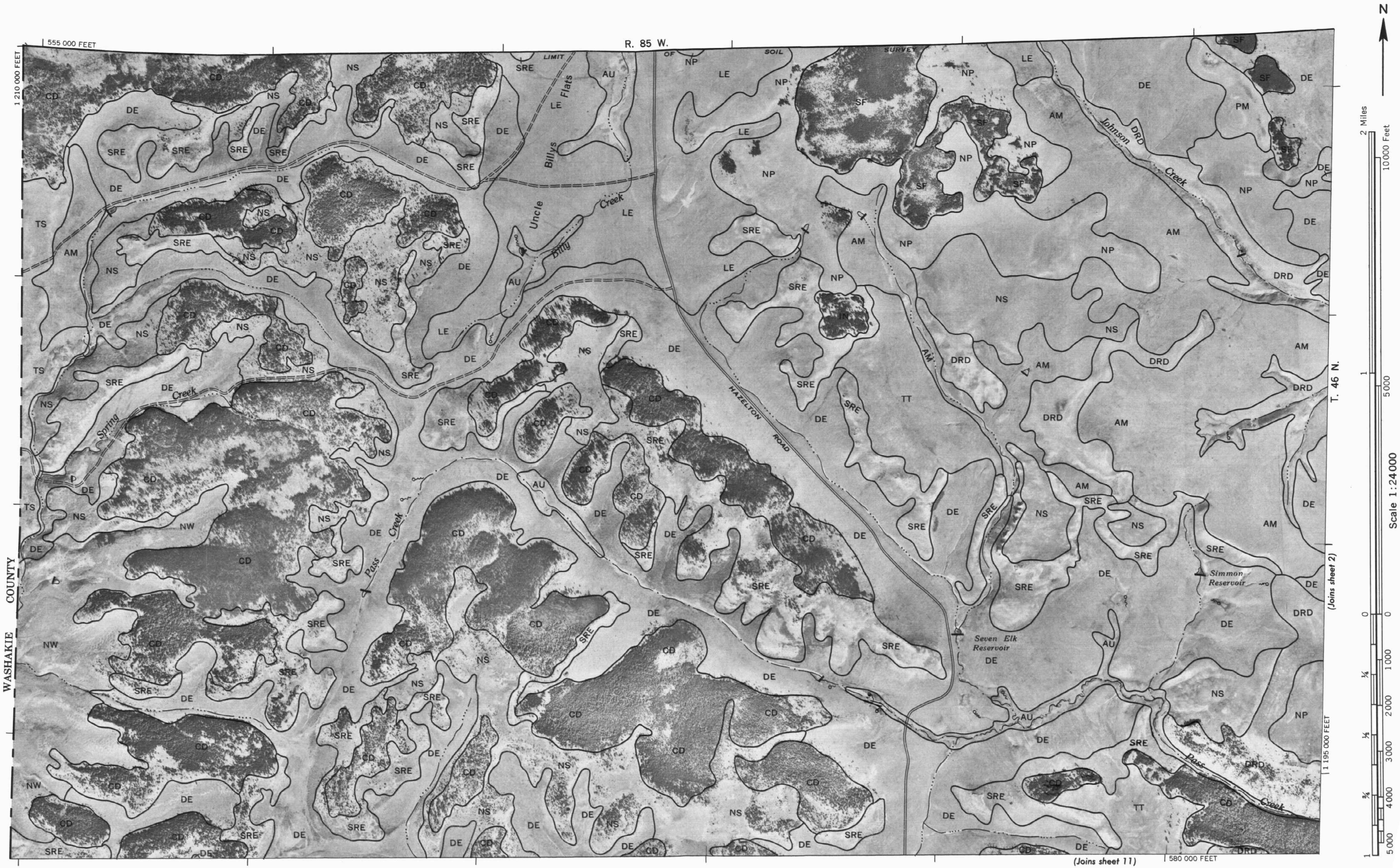
Prominent peak

Depressions (Large, Small)

- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

- Soil boundary and symbol — Dx
- Gravel
- Stoniness
  - Stony
  - Very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully
- Saline spot



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
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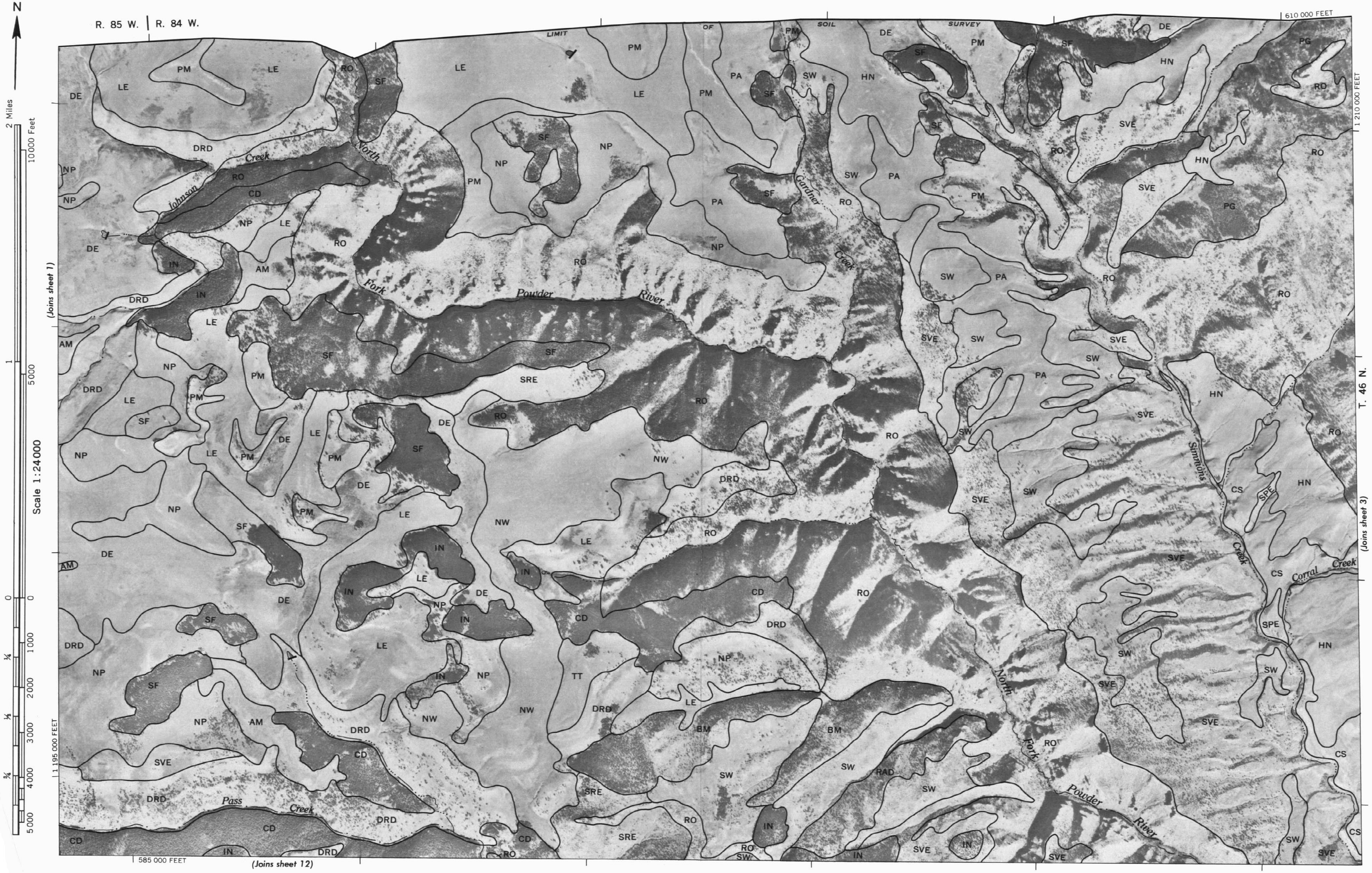
JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 2



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station. Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

3

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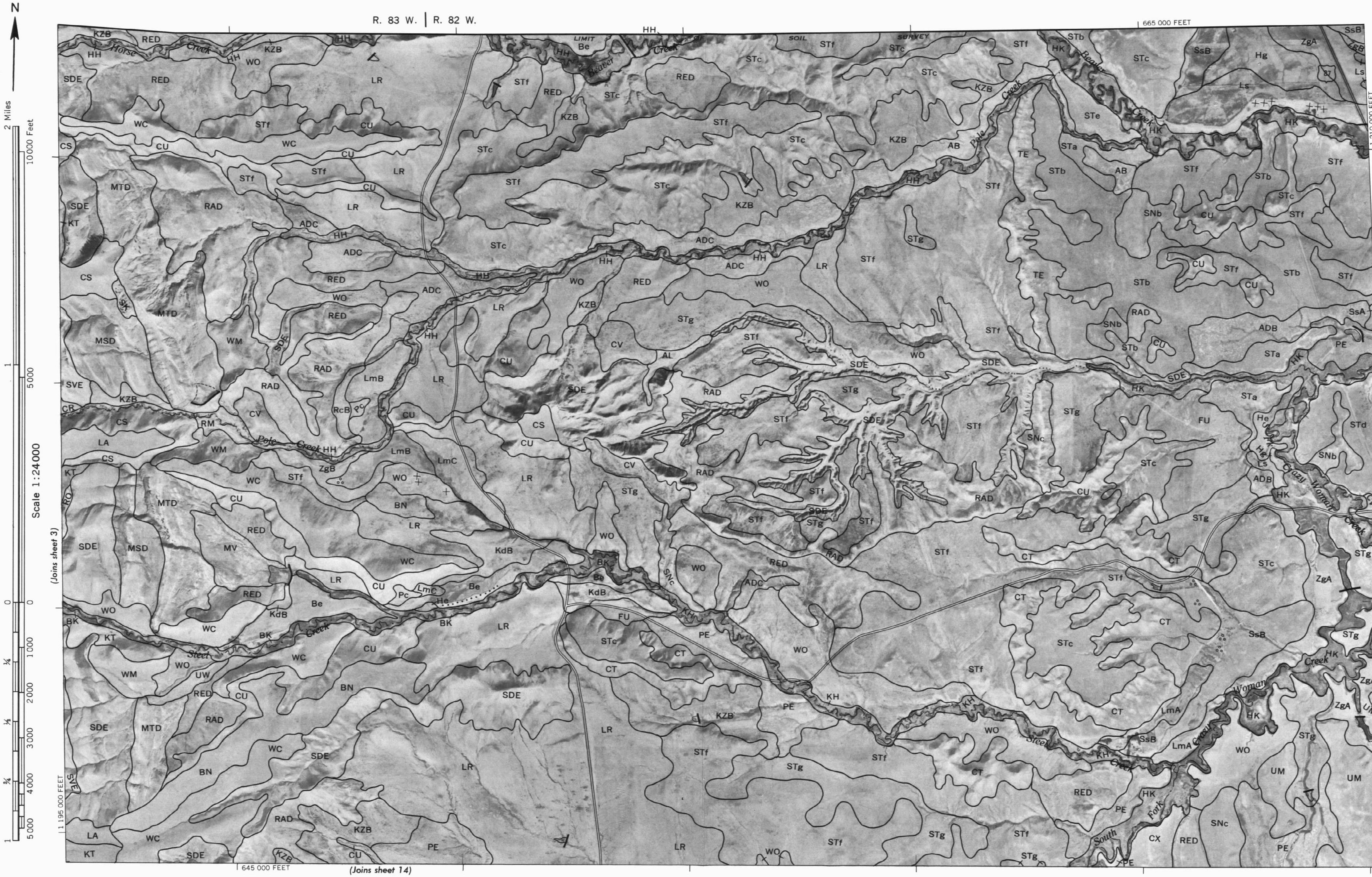

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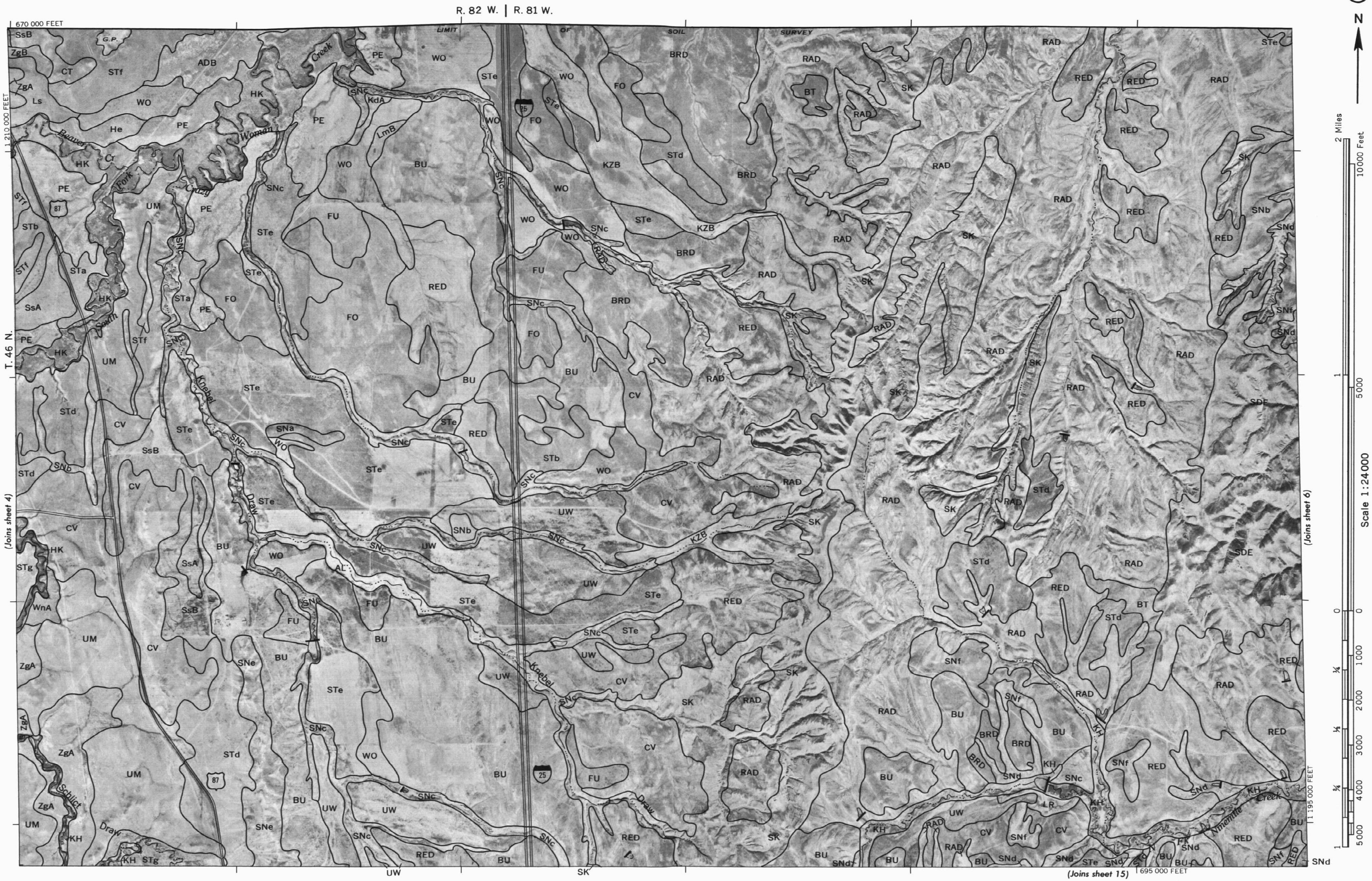
JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 5

(5)



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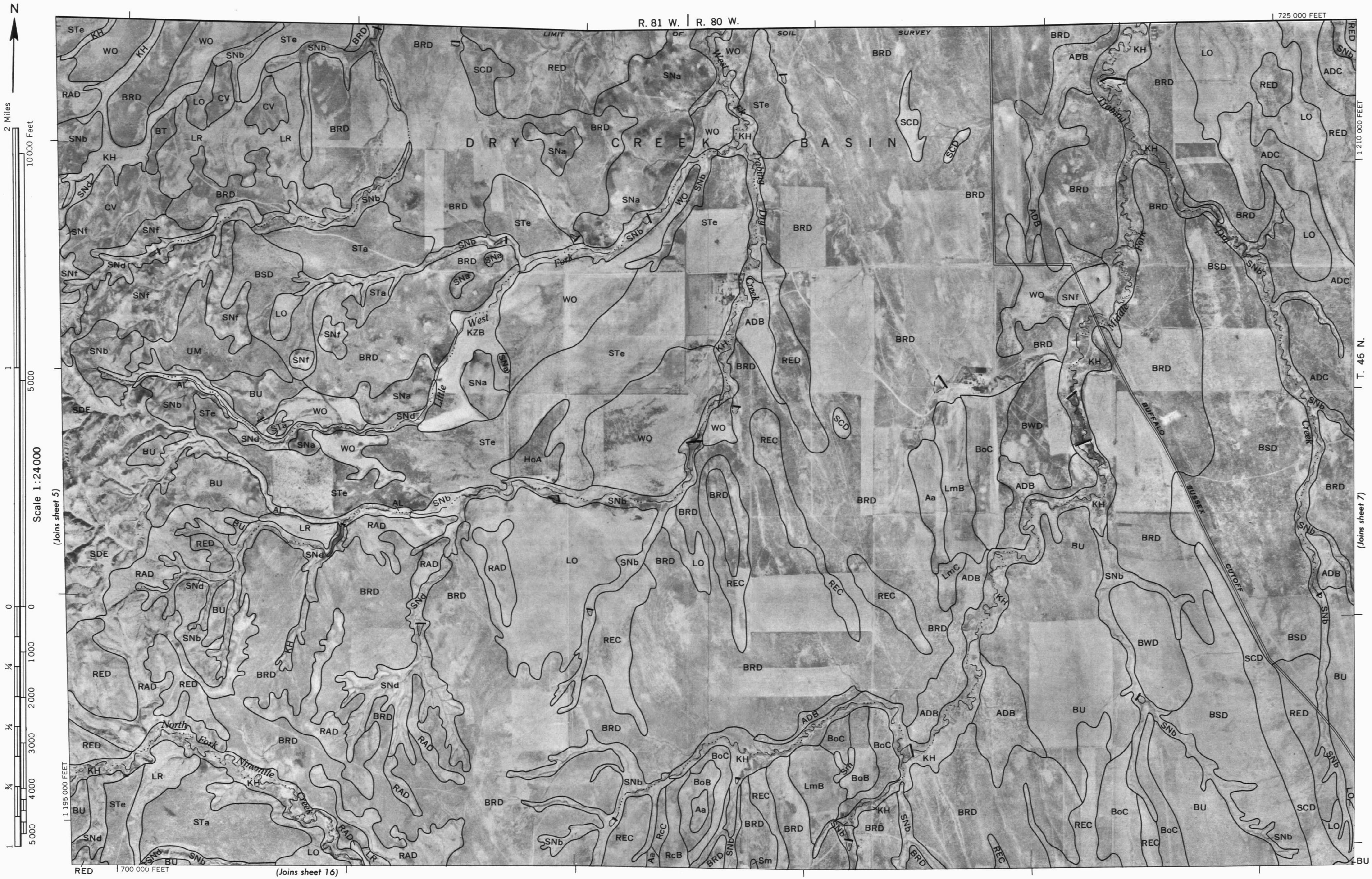
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 6



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JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 7

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
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JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 8

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
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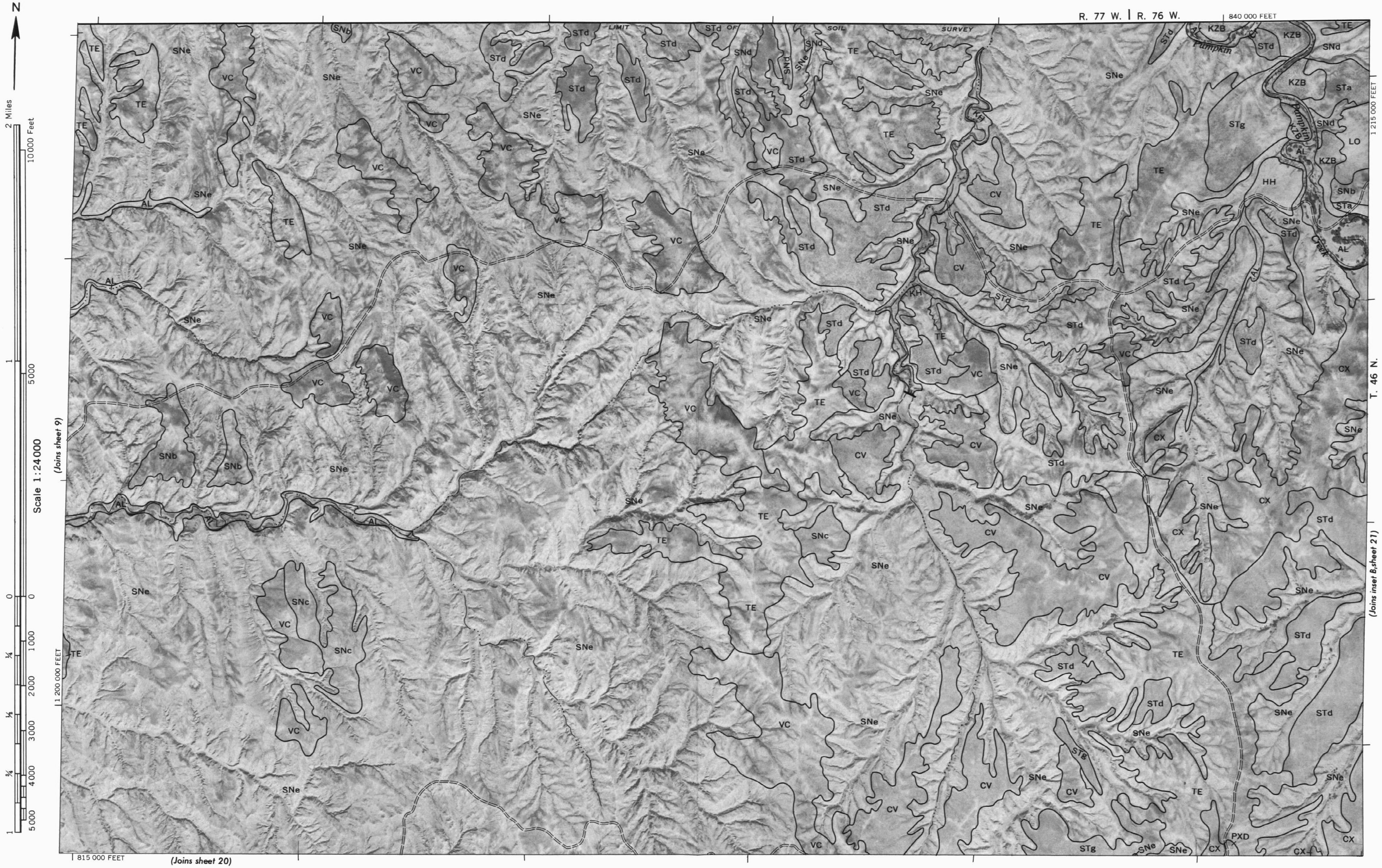
JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 10



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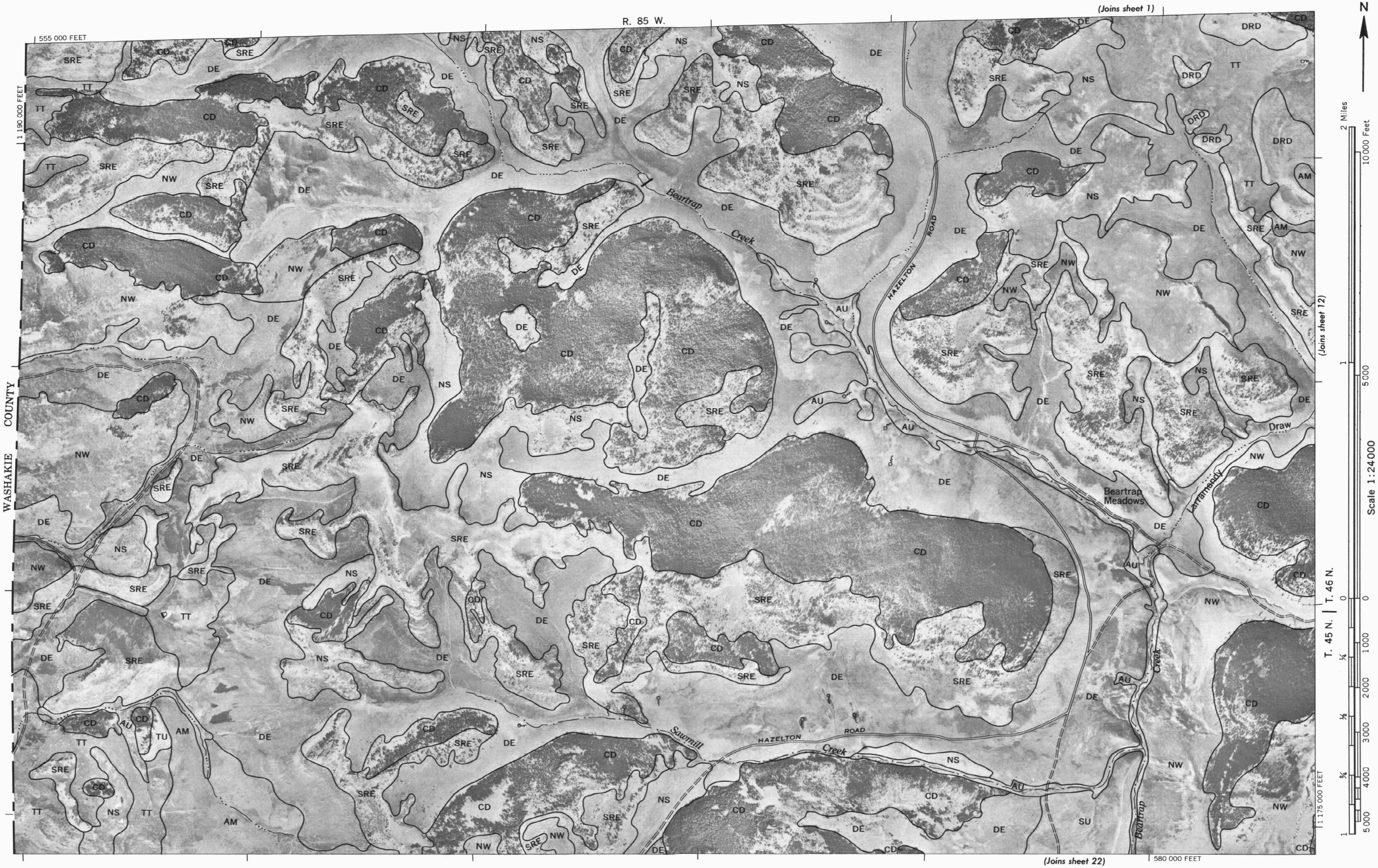

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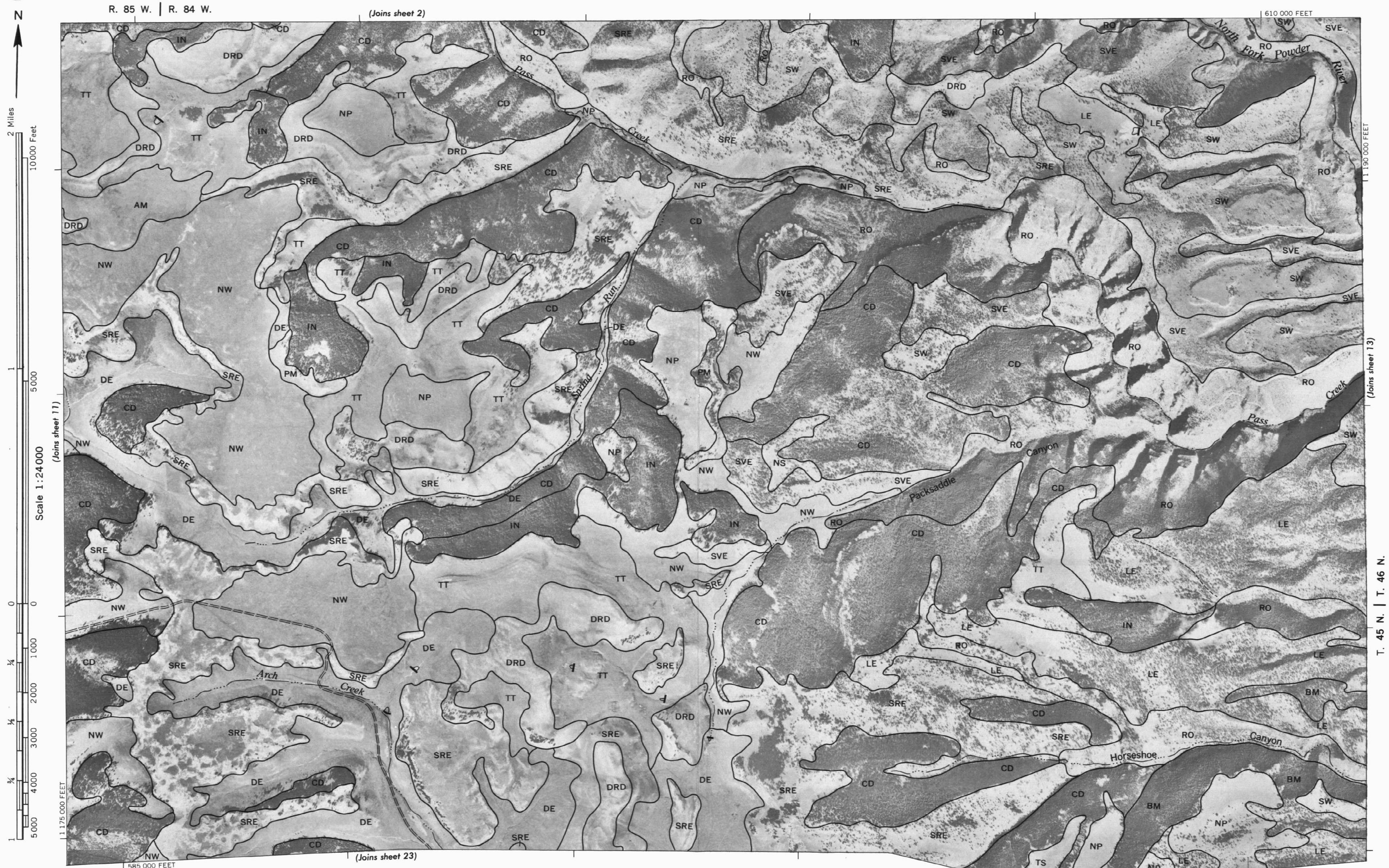

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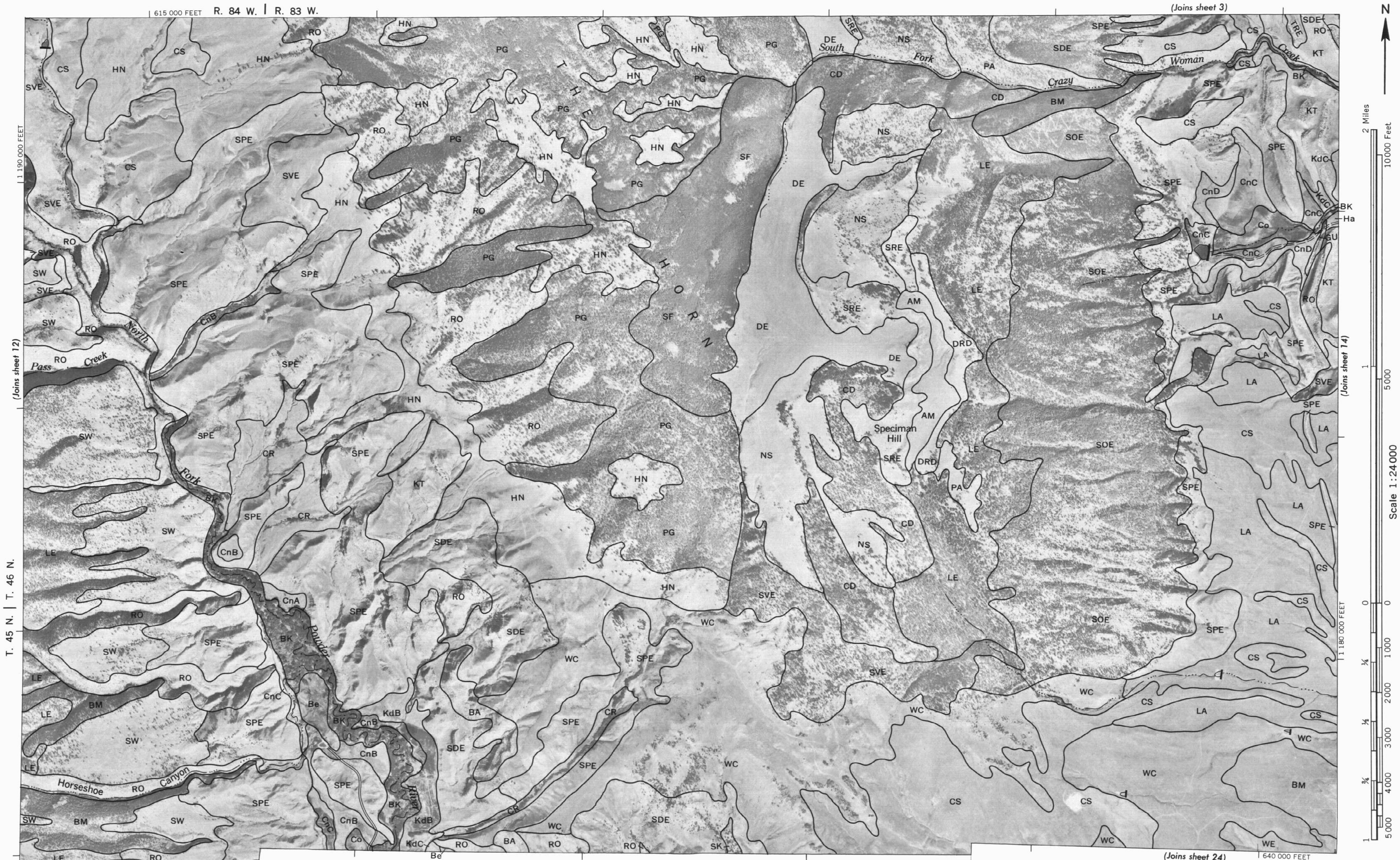

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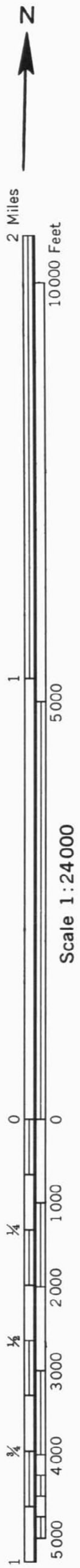
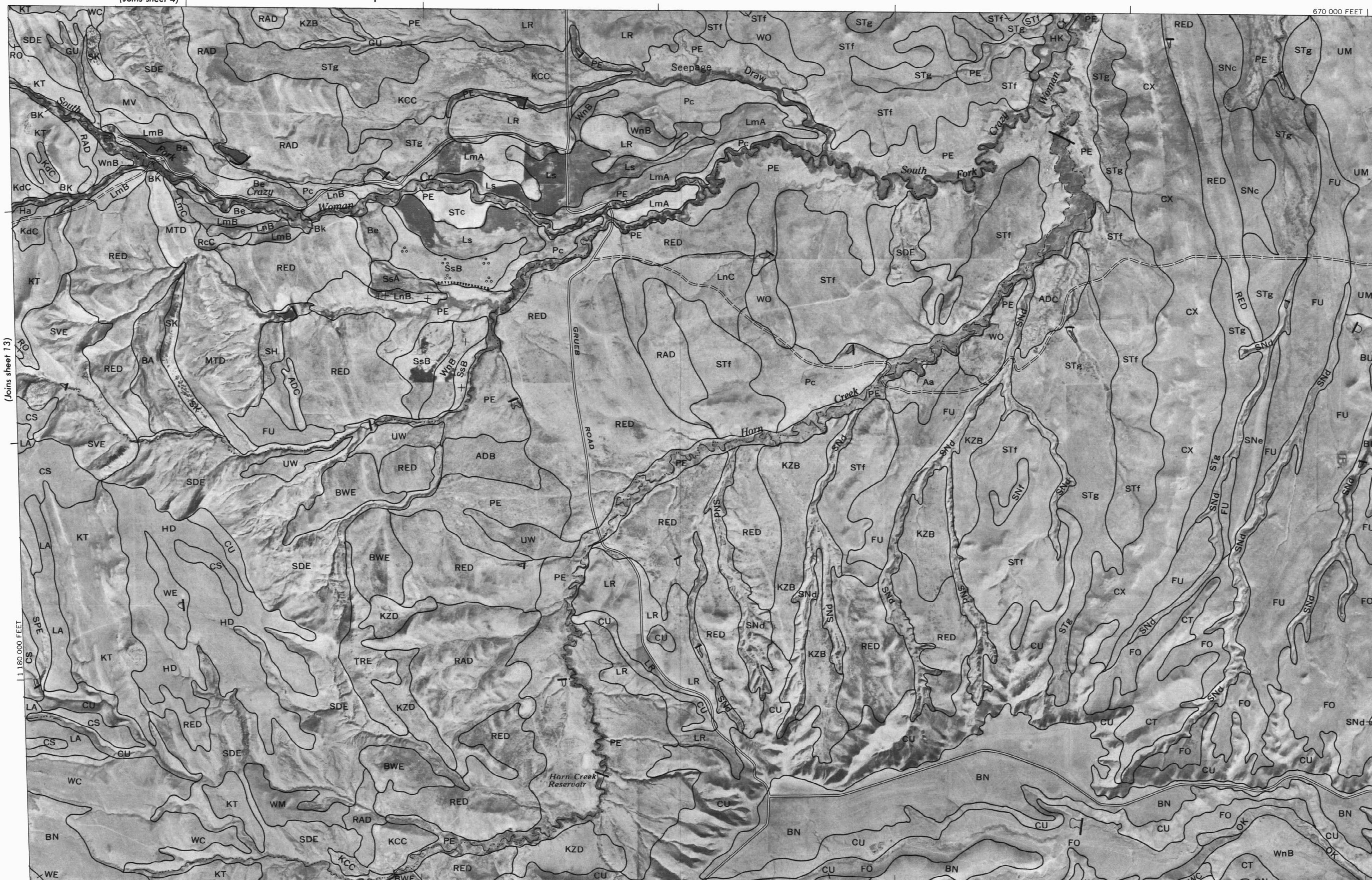
JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 14

(Joins sheet 4)

R. 83 W. | R. 82 W.





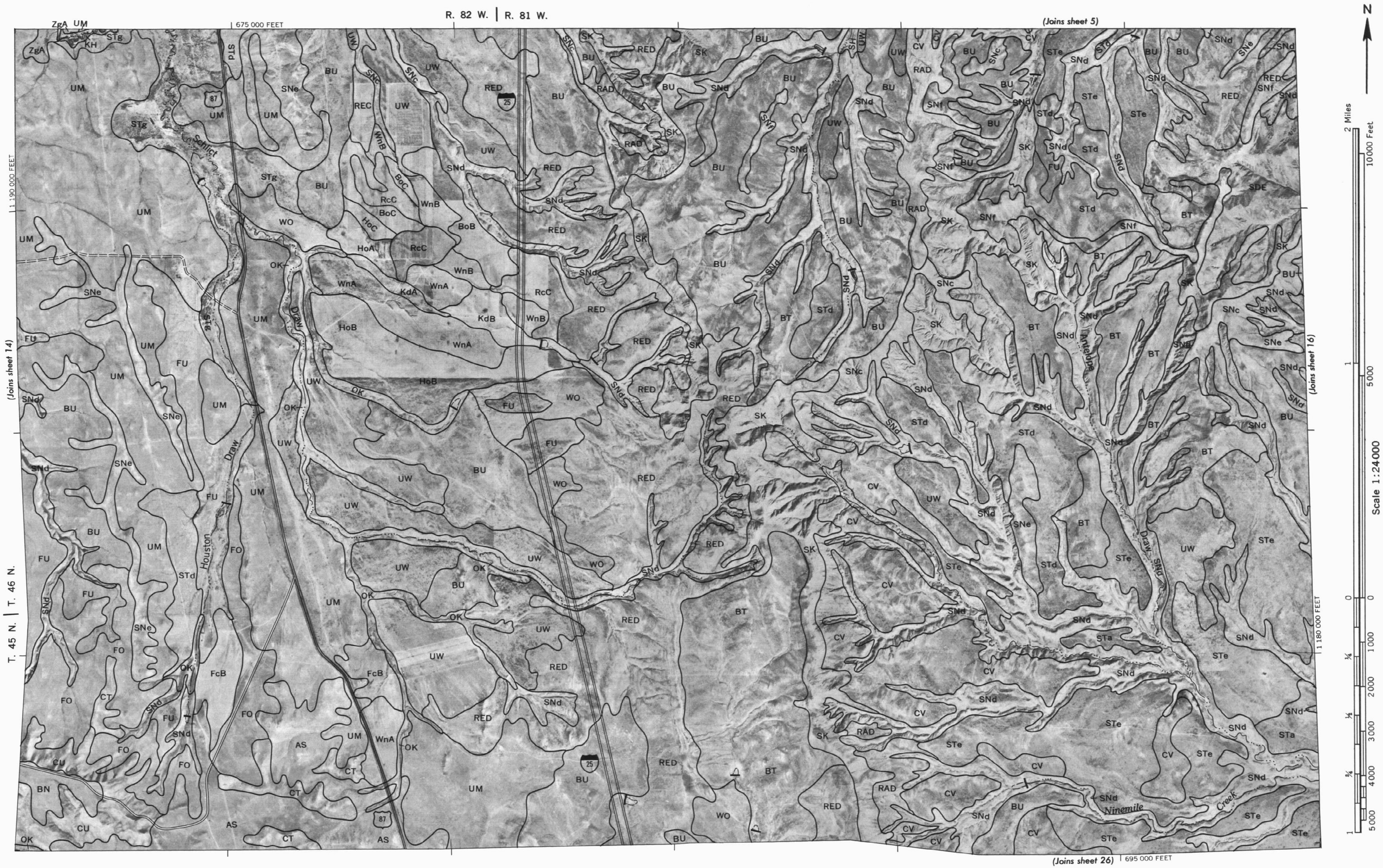
(Joins sheet 13)

(Joins sheet 15)

T. 46 N. | T. 45 N.

(Joins sheet 25)

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



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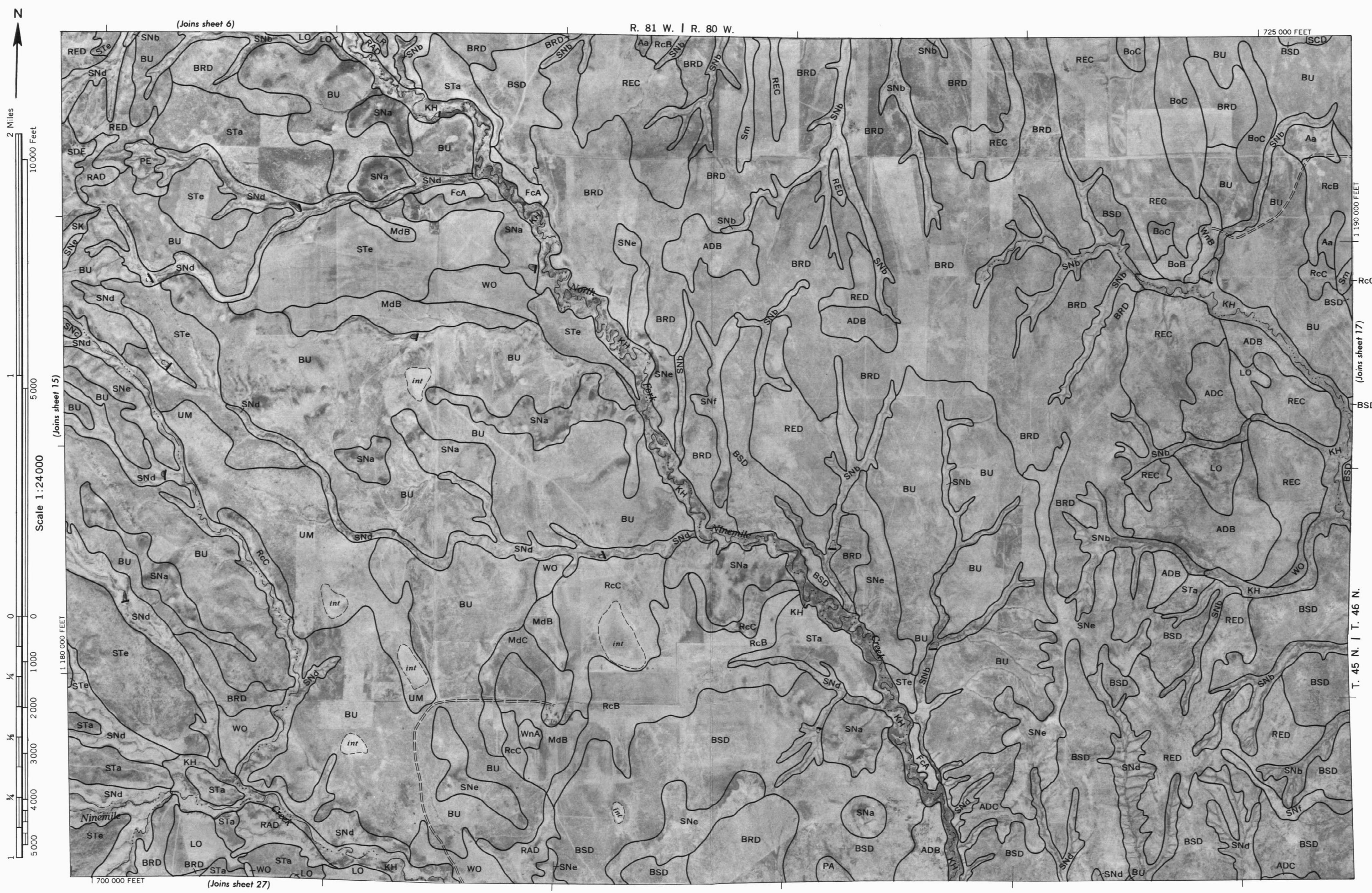

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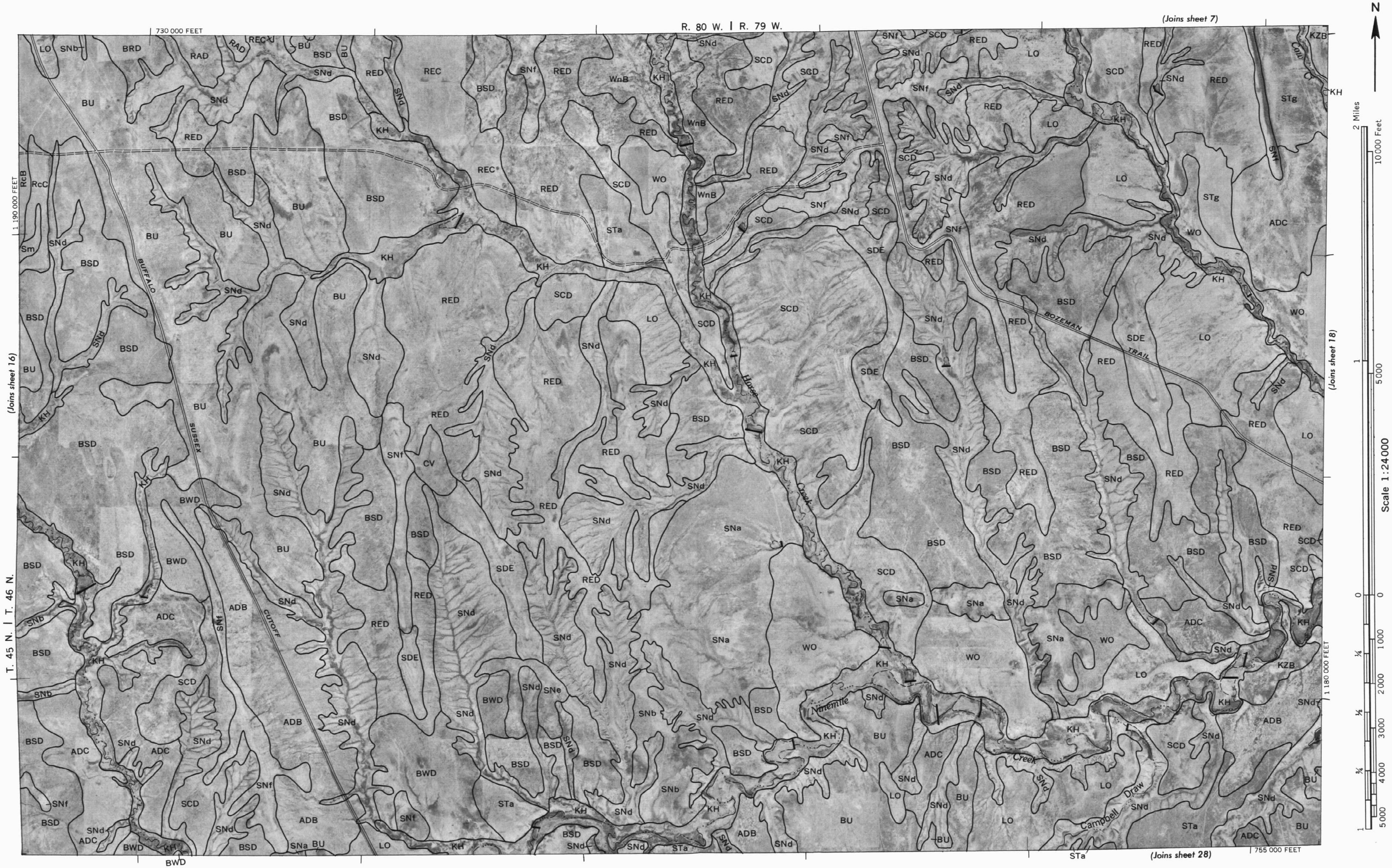
Photobase from 1954 and 1958 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



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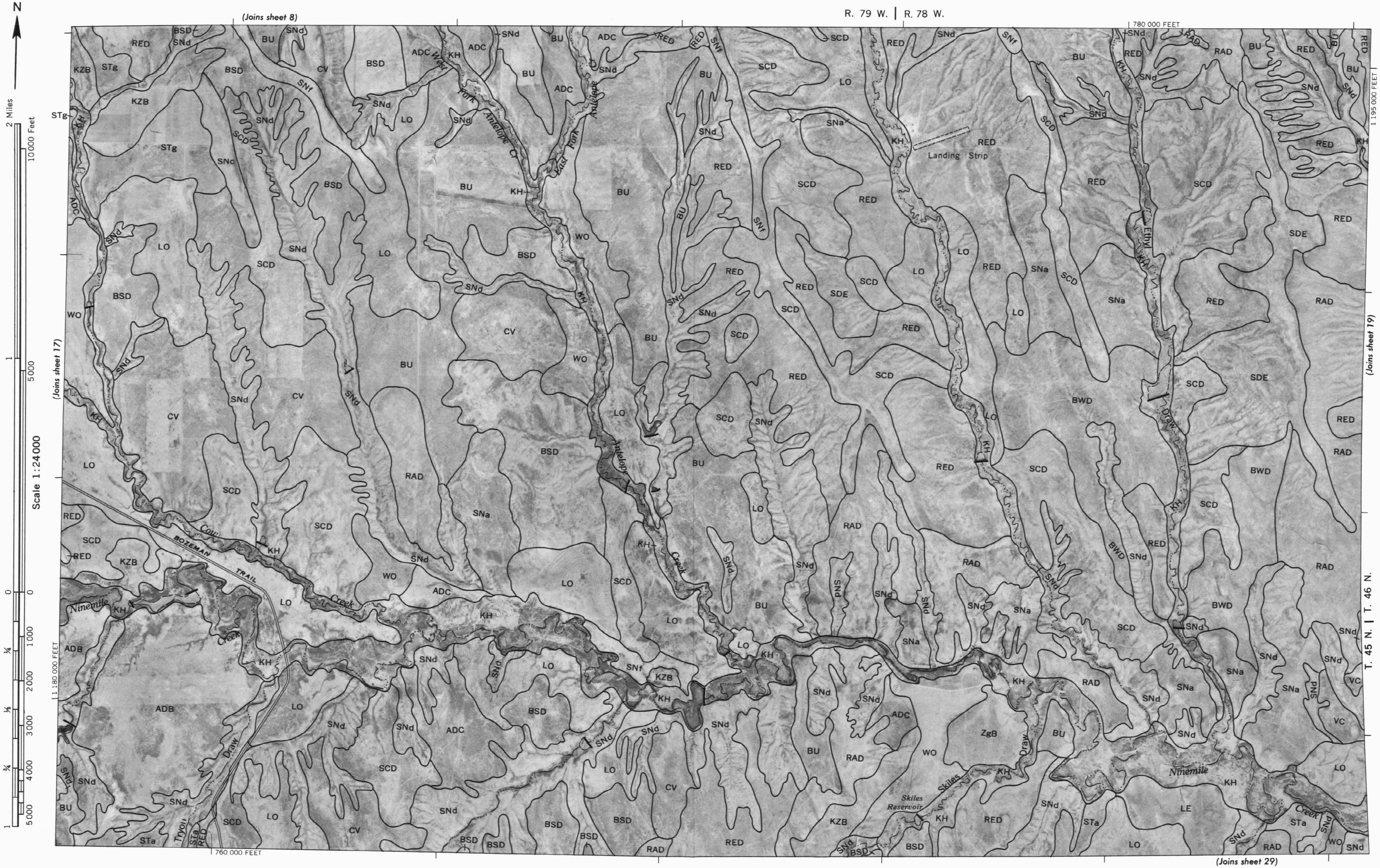
18



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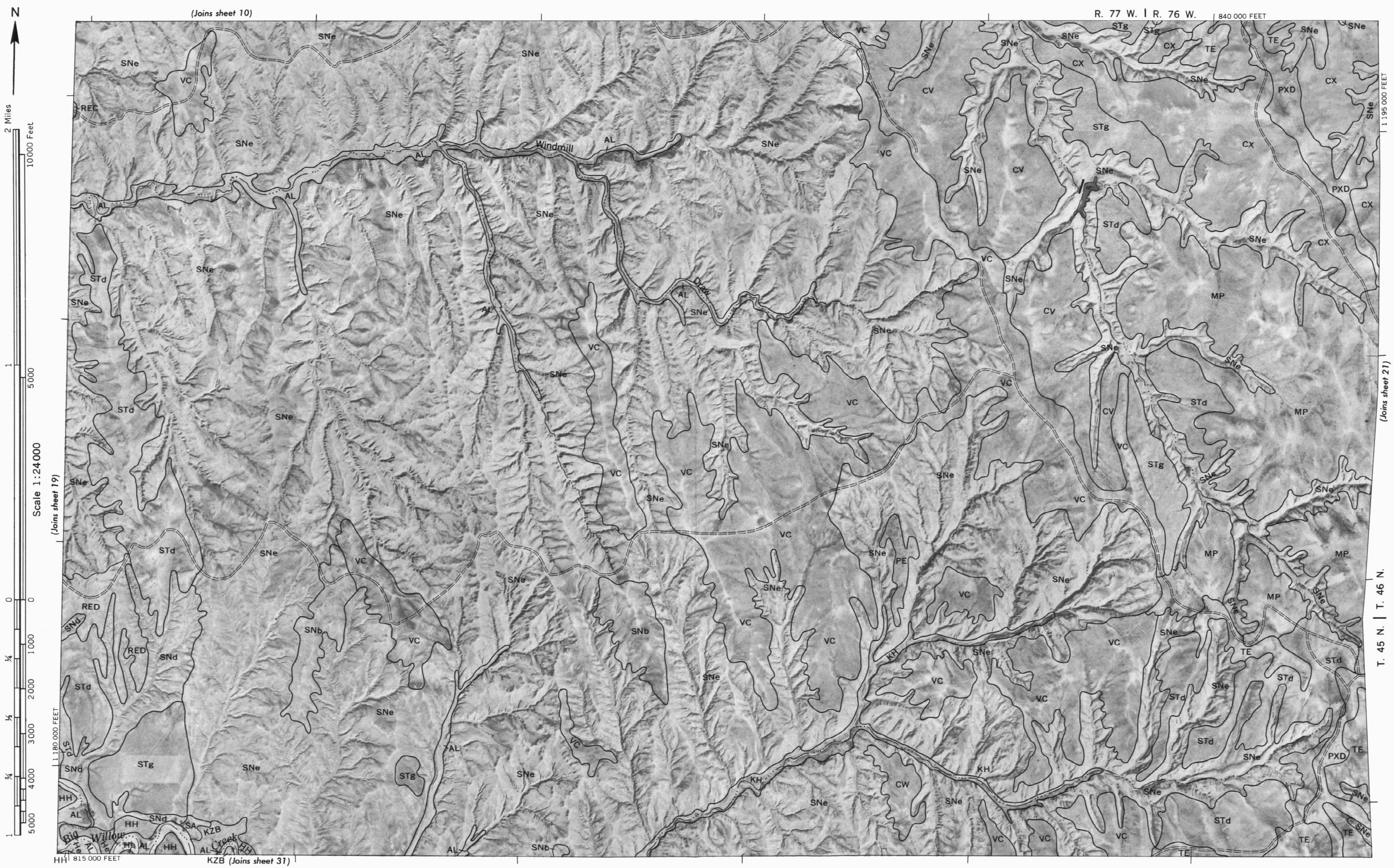

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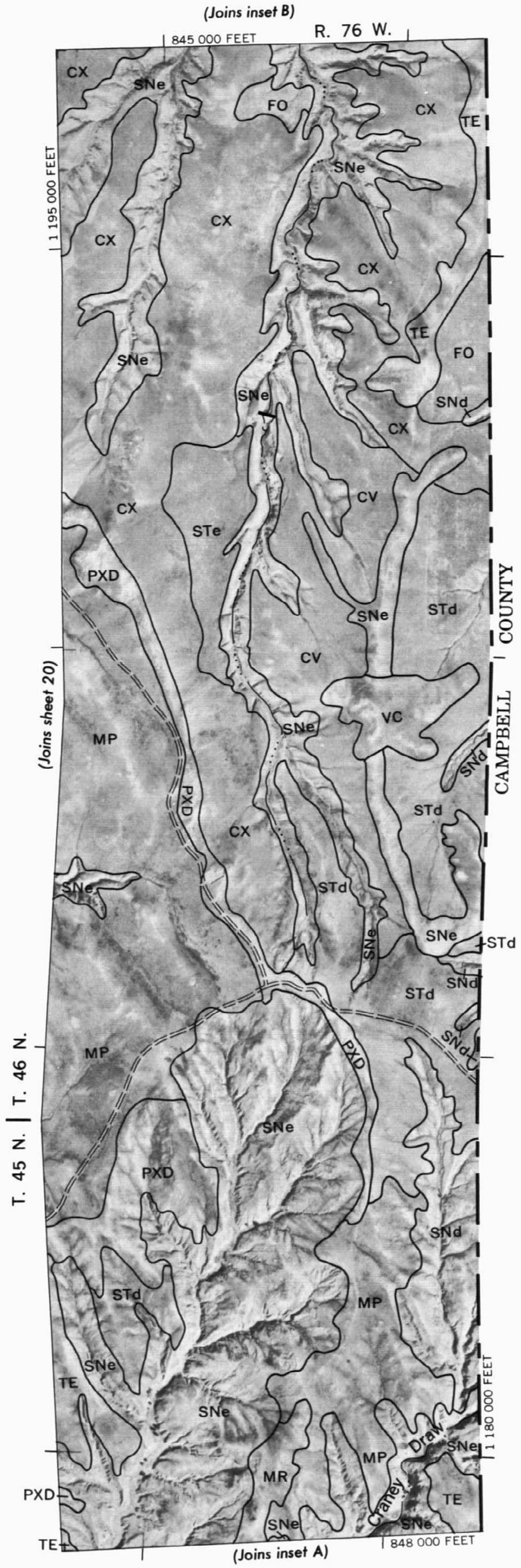
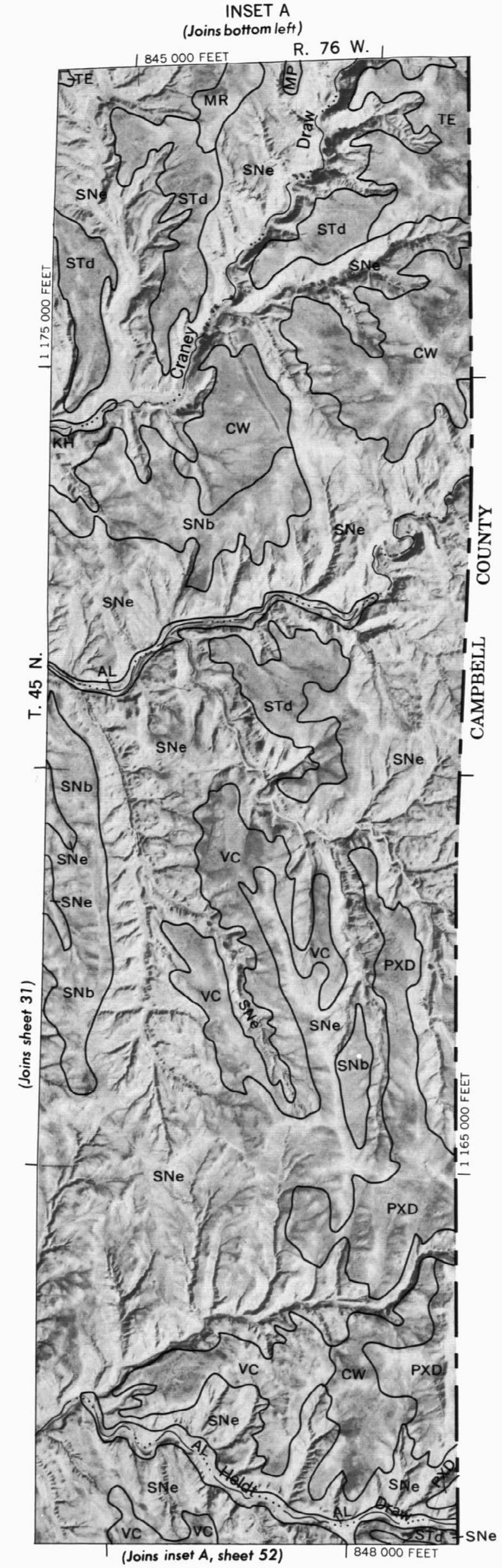
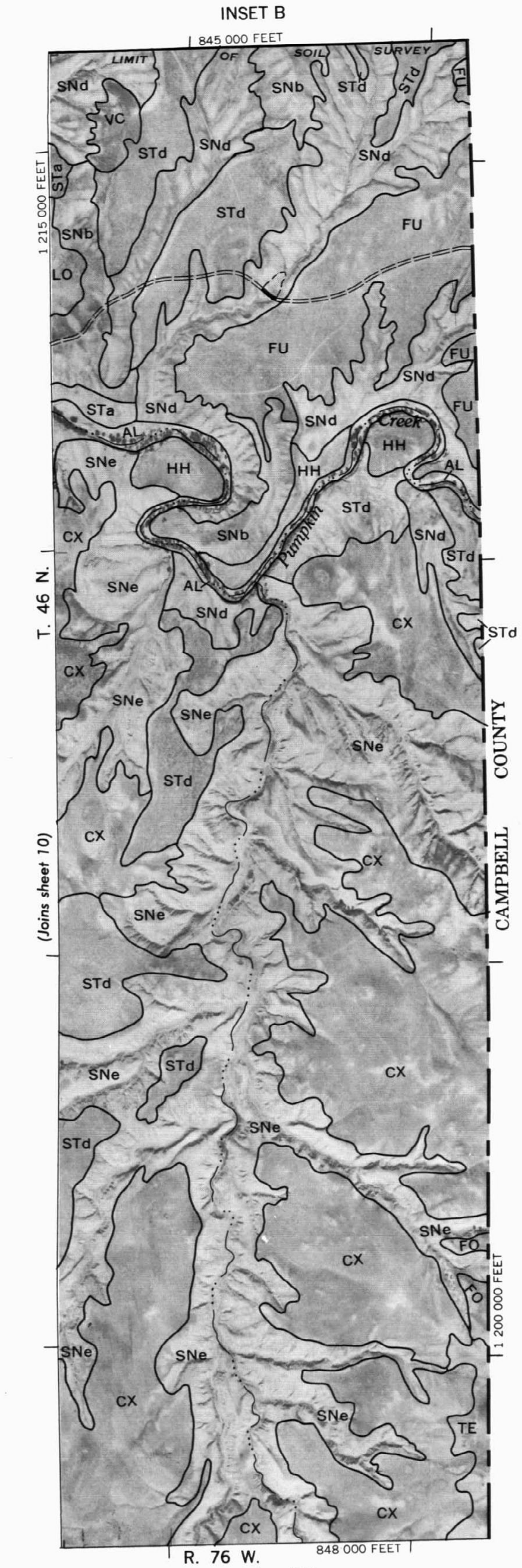


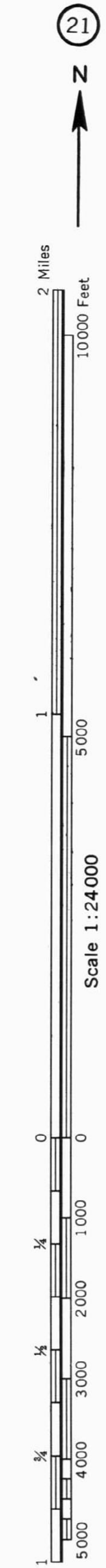
3000 AND 5000-FOOT GRID TICKS

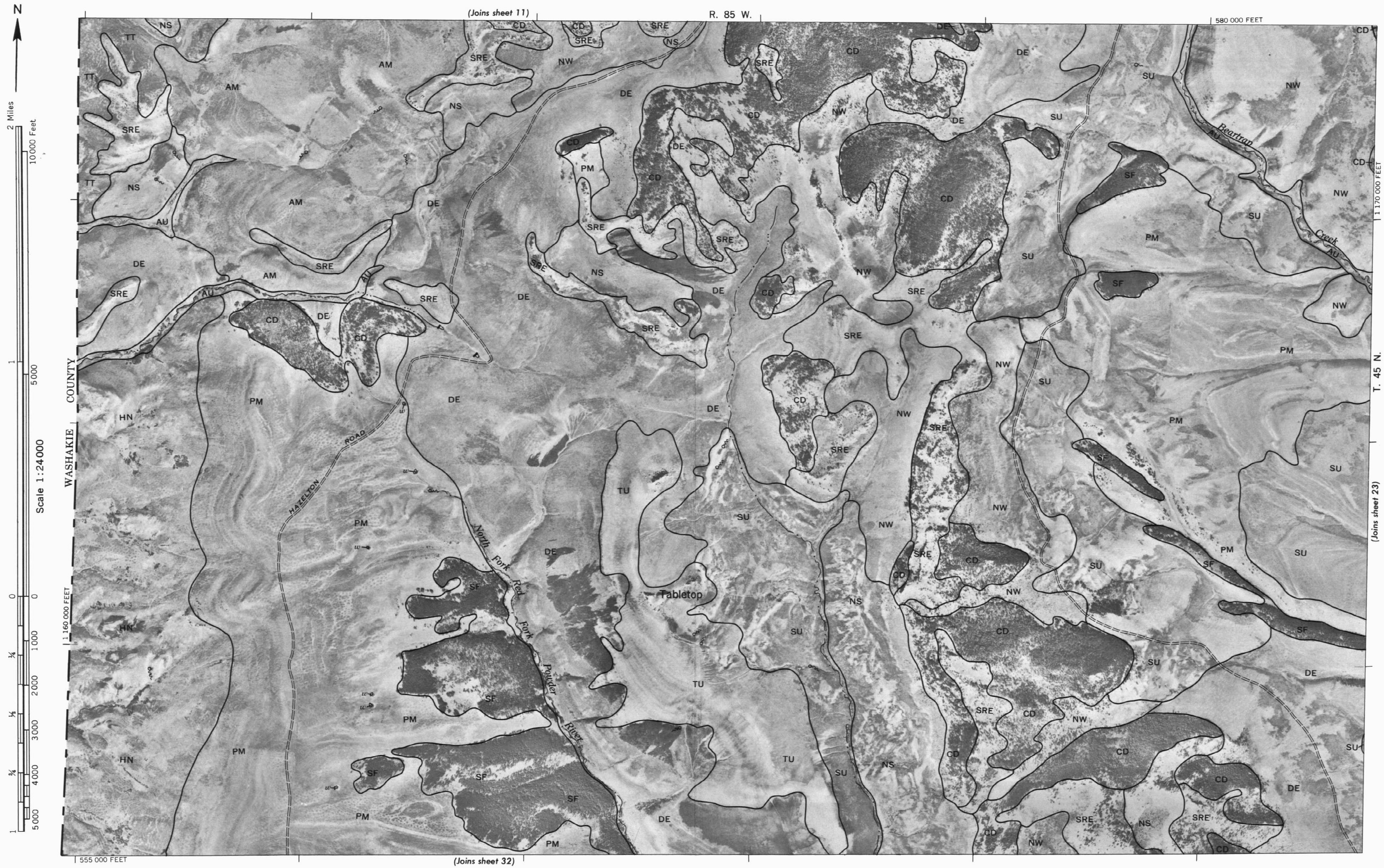


3000 AND 5000-FOOT GRID TICKS



3000 AND 5000-FOOT GRID TICKS





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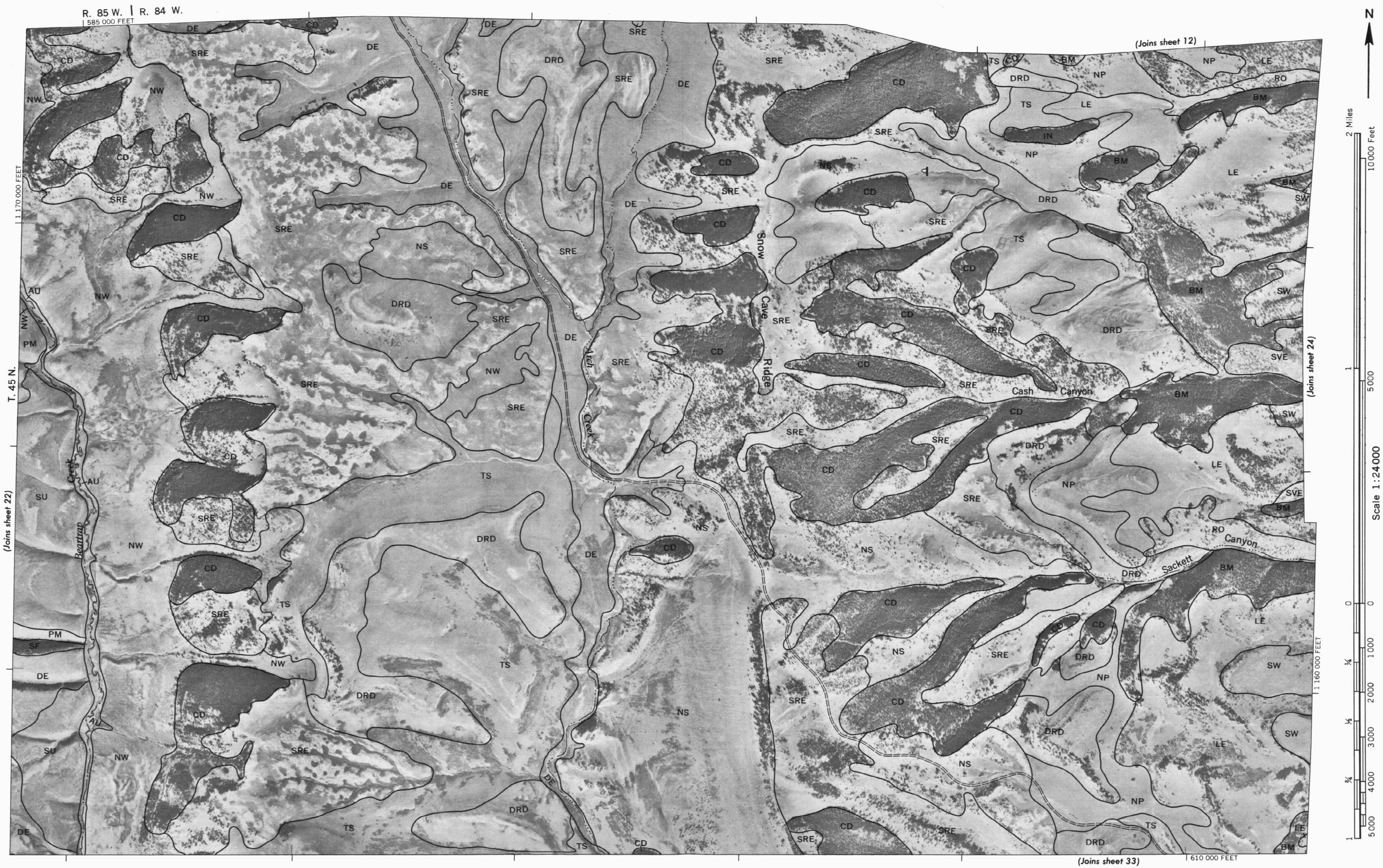

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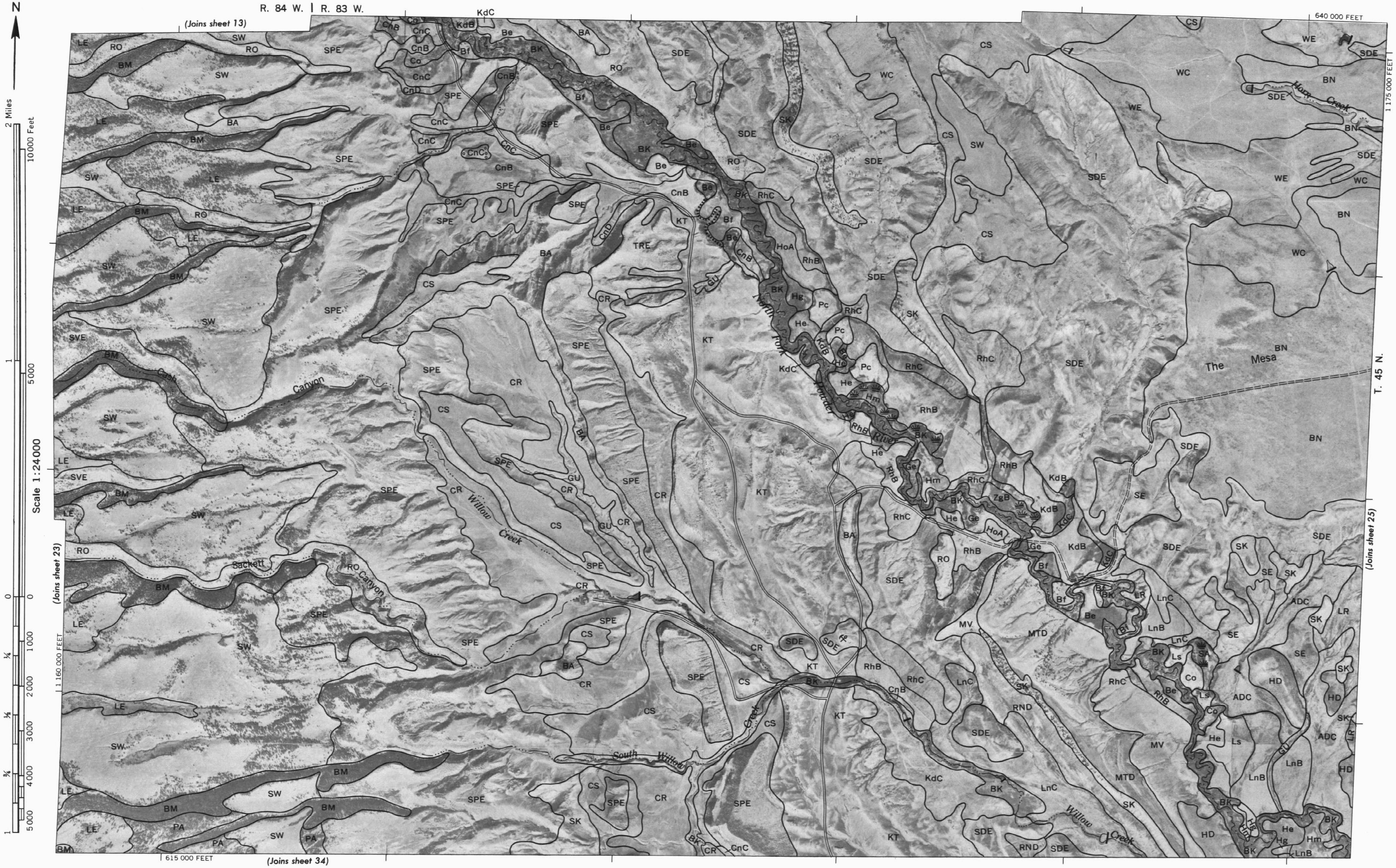

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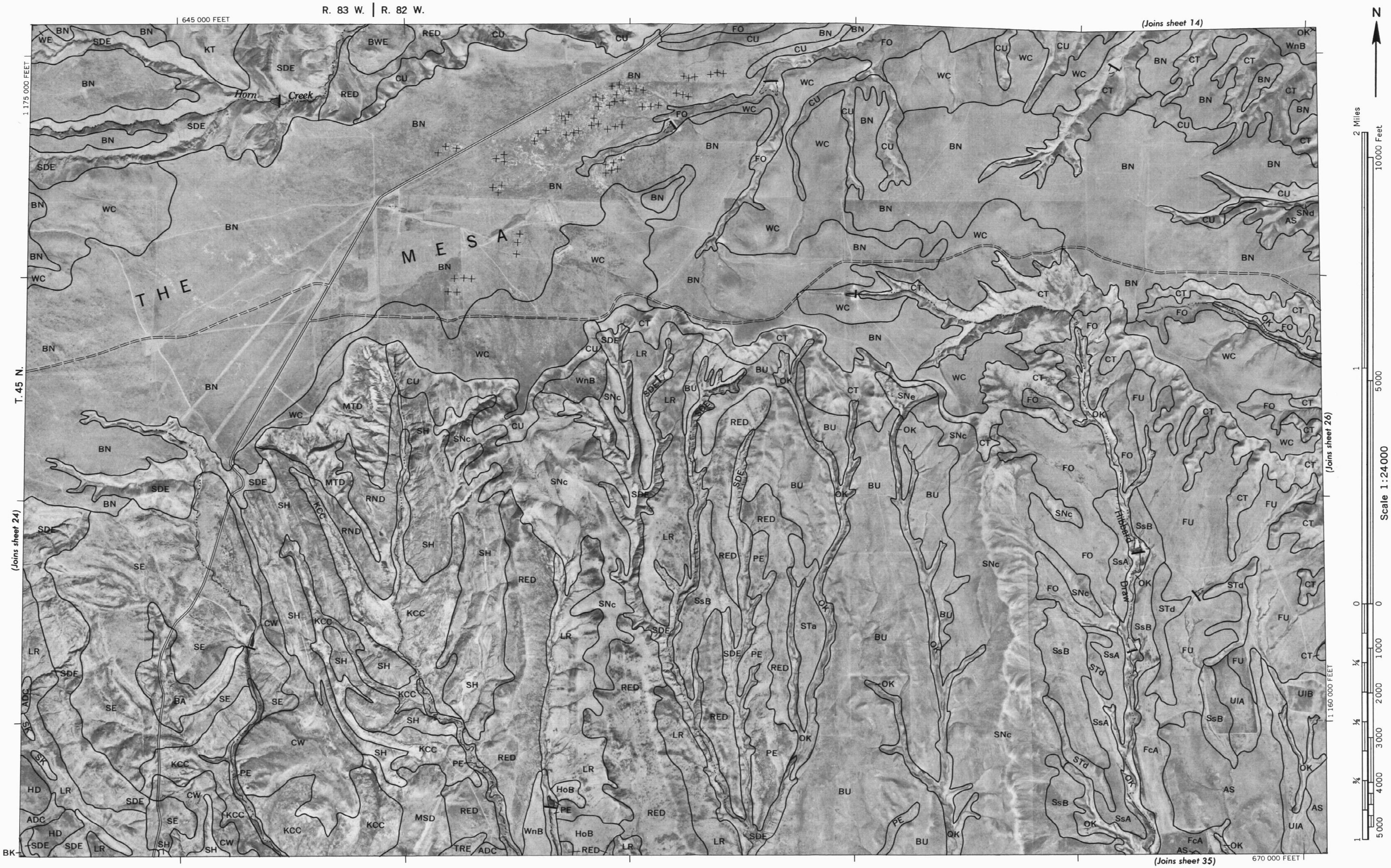
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 25



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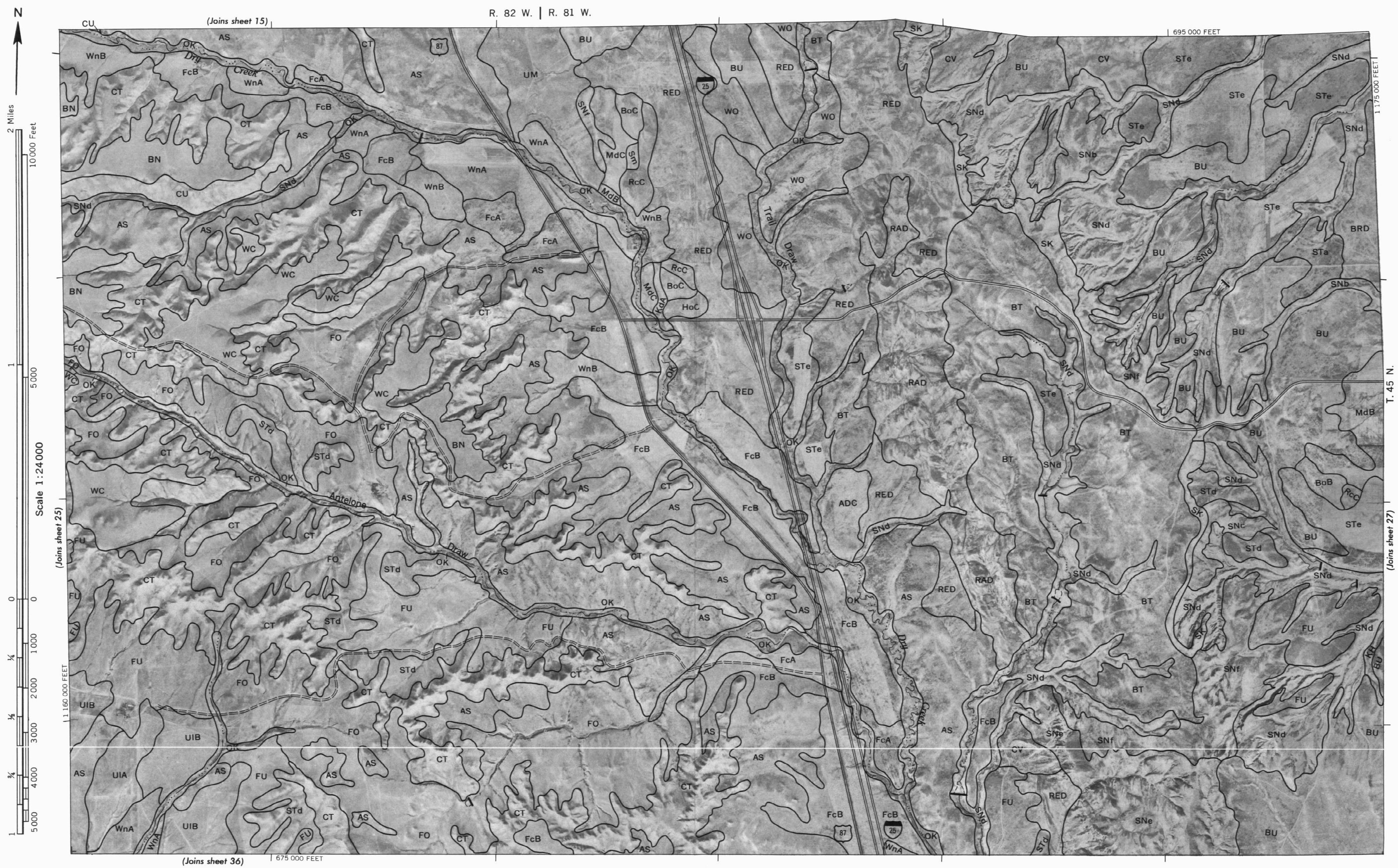
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 26



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
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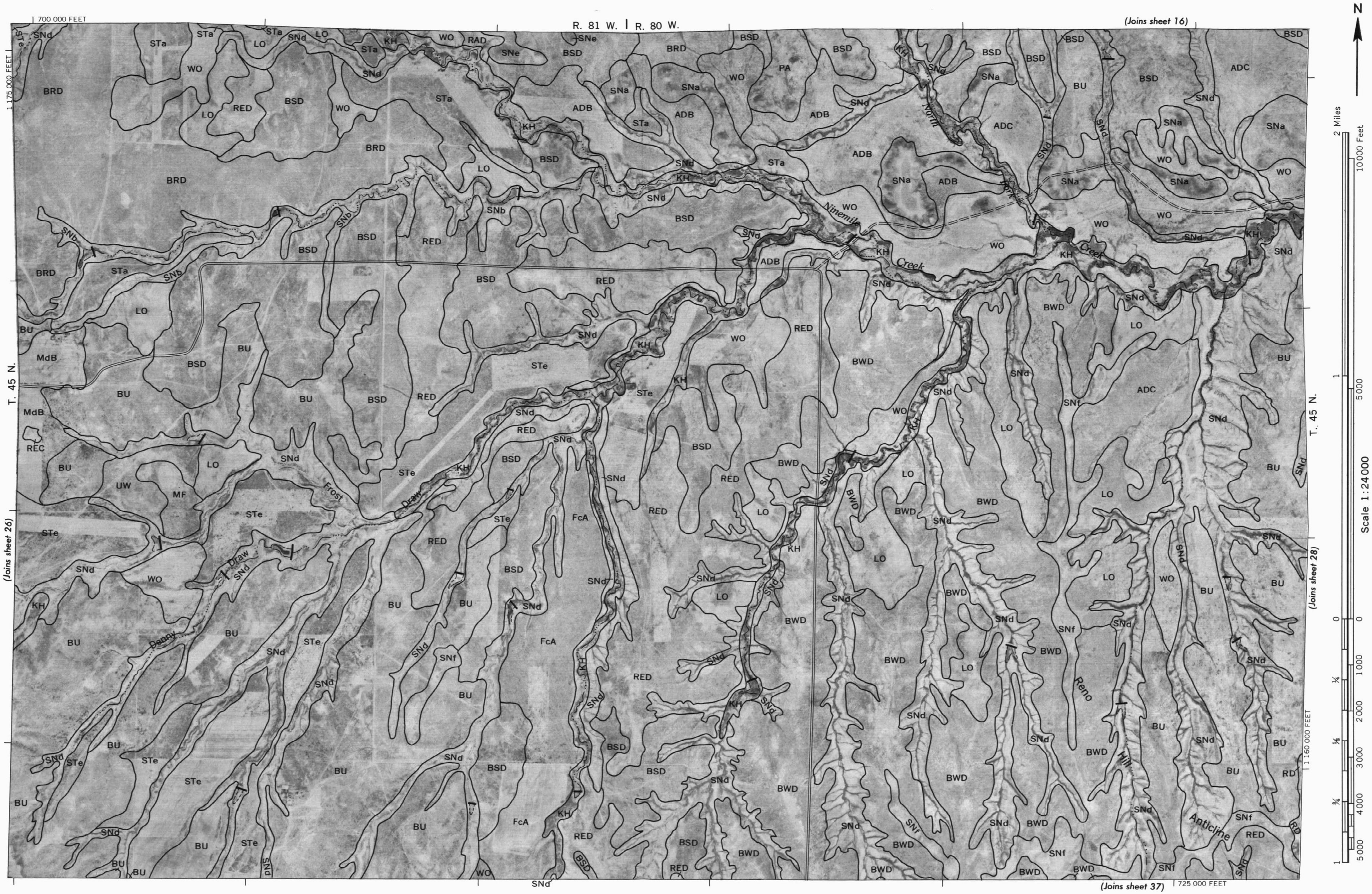

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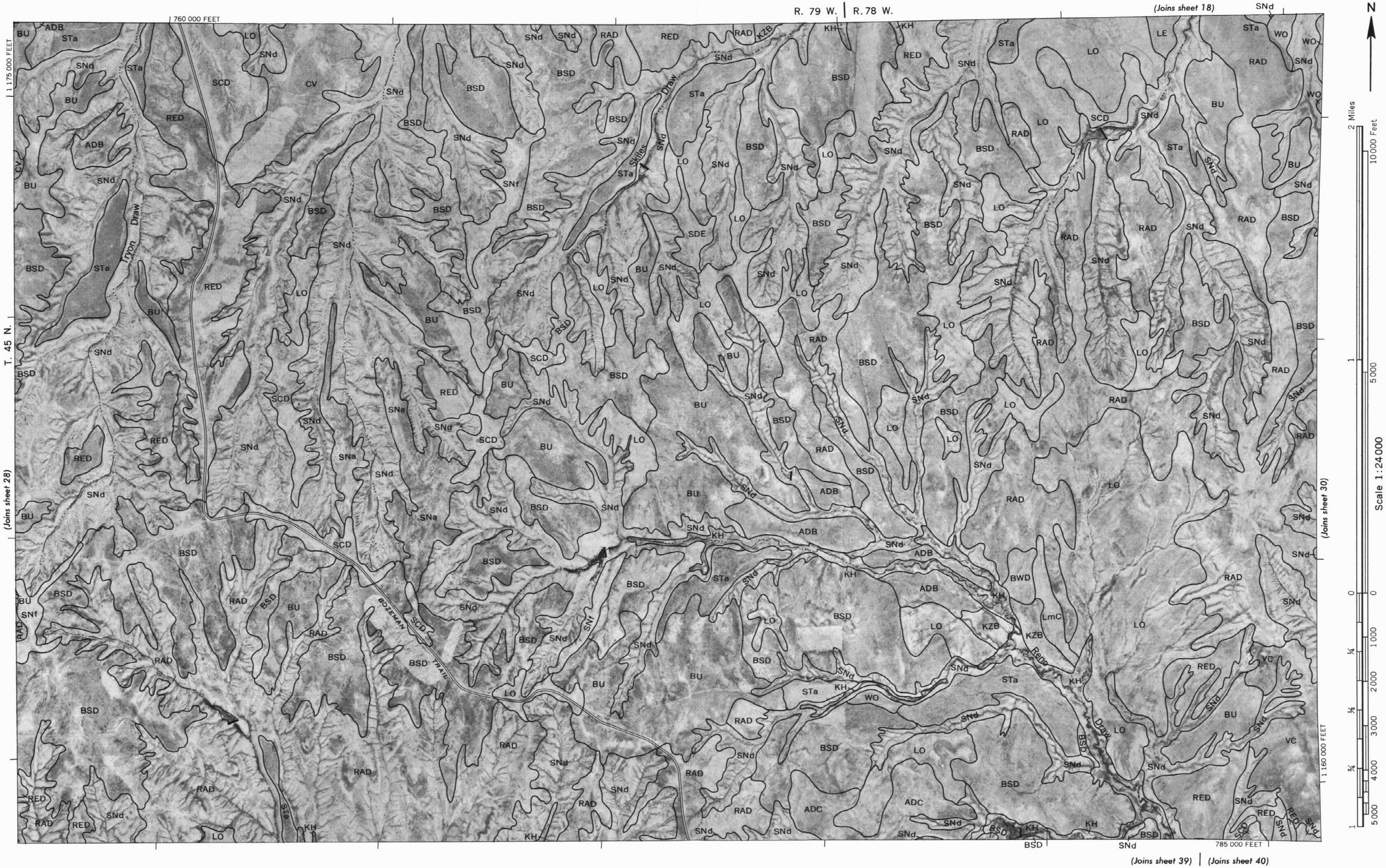
JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 28

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
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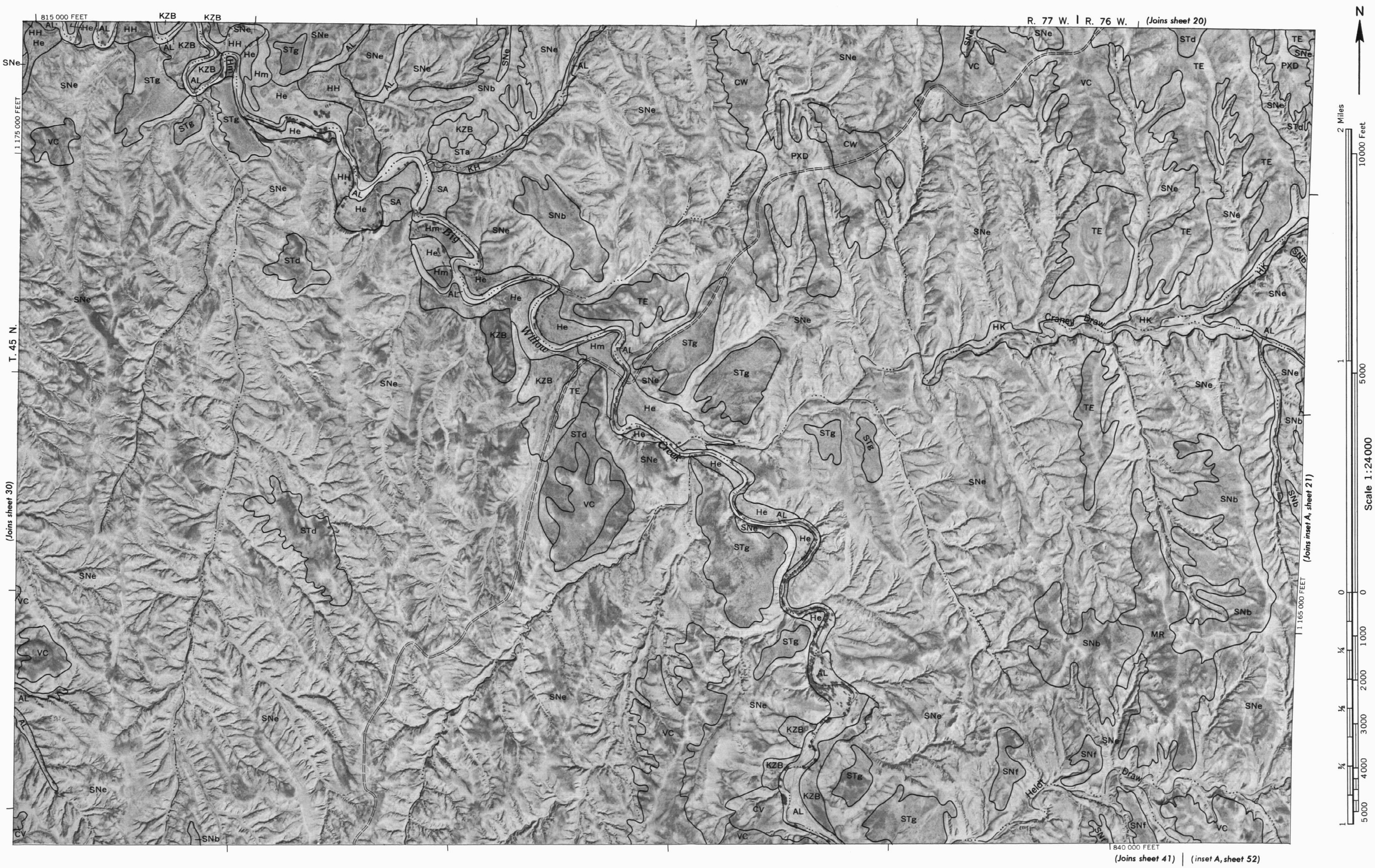

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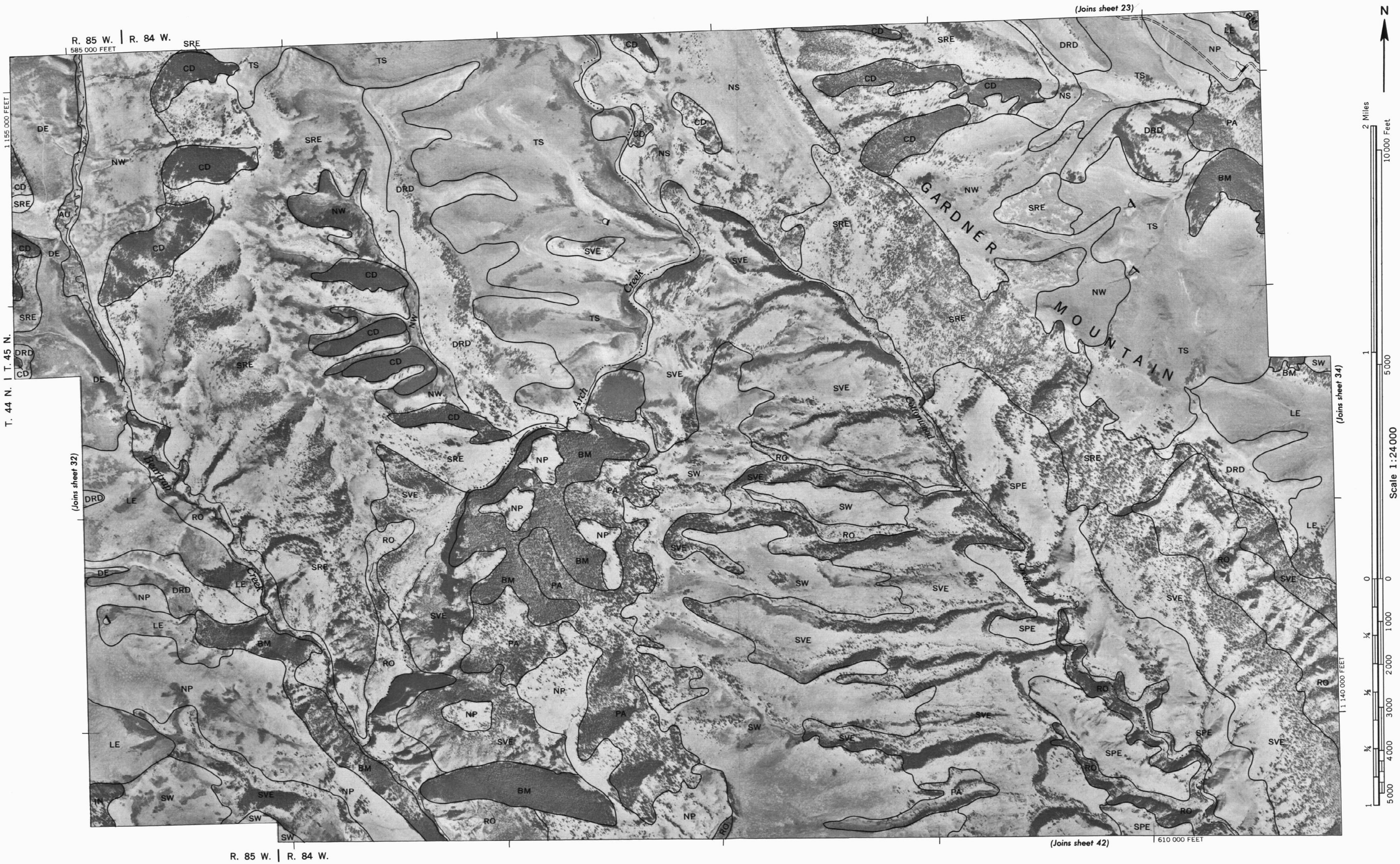
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.


N
2 Miles
10 000 Feet
5000
Scale 1:24000
(Joins sheet 22)
R. 85 W.
580 000 FEET
1 155 000 FEET
T. 45 N.
T. 44 N.
(Joins sheet 33)
(Joins sheet 42)
560 000 FEET
1 140 000 FEET
WASHAKIE COUNTY
HAZELTON ROAD
The Castle Rock
North Fork Powder River
Baldwin Creek
HN
PM
SF
SU
TU
DE
AU
NS
CD
NW
SRE
DRD
LE
TT
NP
IN
RO


(Joins sheet 23)
(Joins sheet 32)
(Joins sheet 34)
(Joins sheet 42)
R. 85 W. | R. 84 W.
585 000 FEET
1 155 000 FEET
T. 45 N.
T. 44 N.
1 140 000 FEET
610 000 FEET
GARDNER MOUNTAIN
Arch Creek
Cottonwood Creek
N
2 Miles
10 000 Feet
Scale 1:24000

JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 34

N

Scale 1:24000

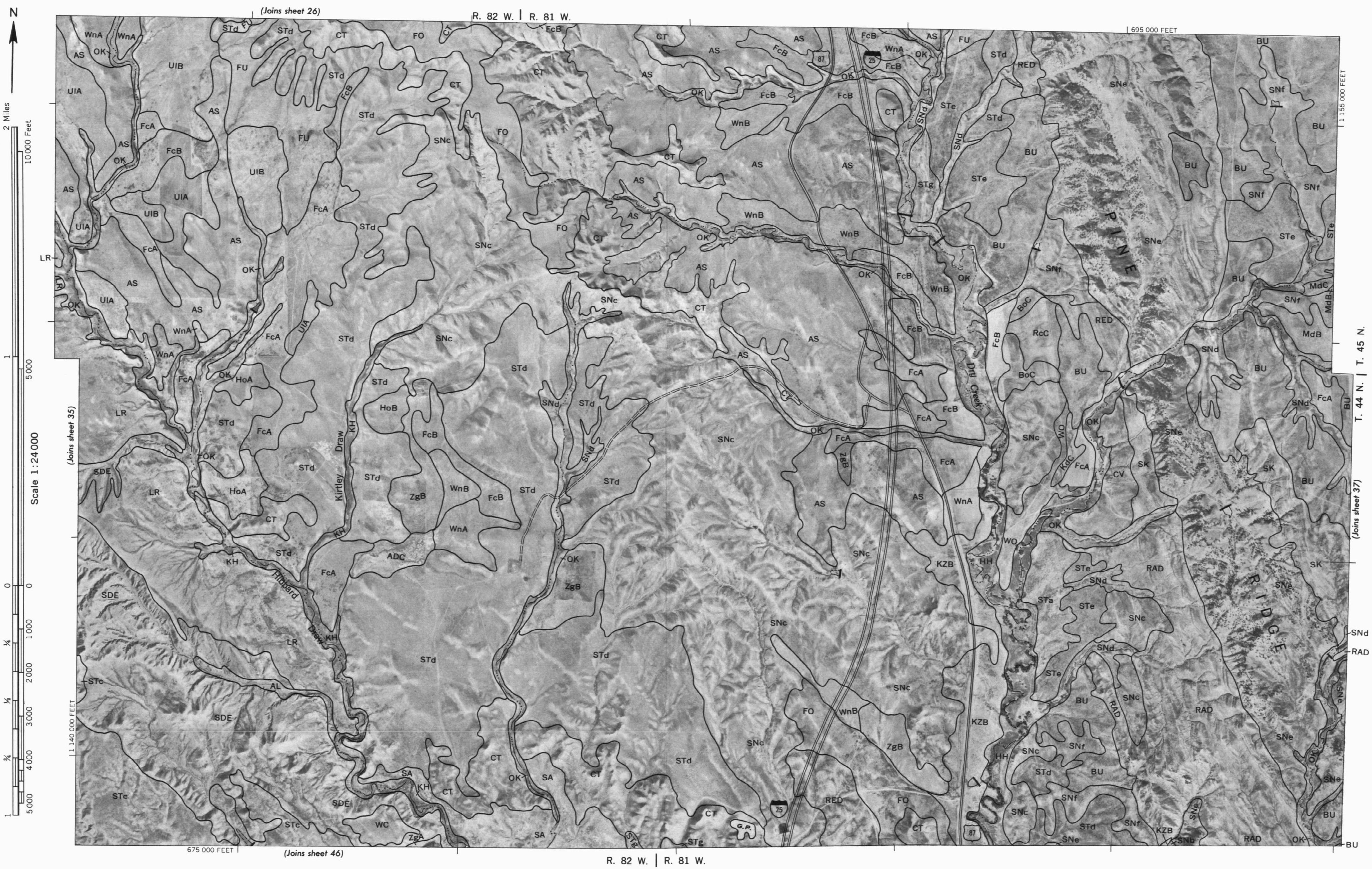
2 Miles 1 0 ¼ ½ ¾ 1

10000 Feet 5000 0 1000 2000 3000 4000 5000

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.

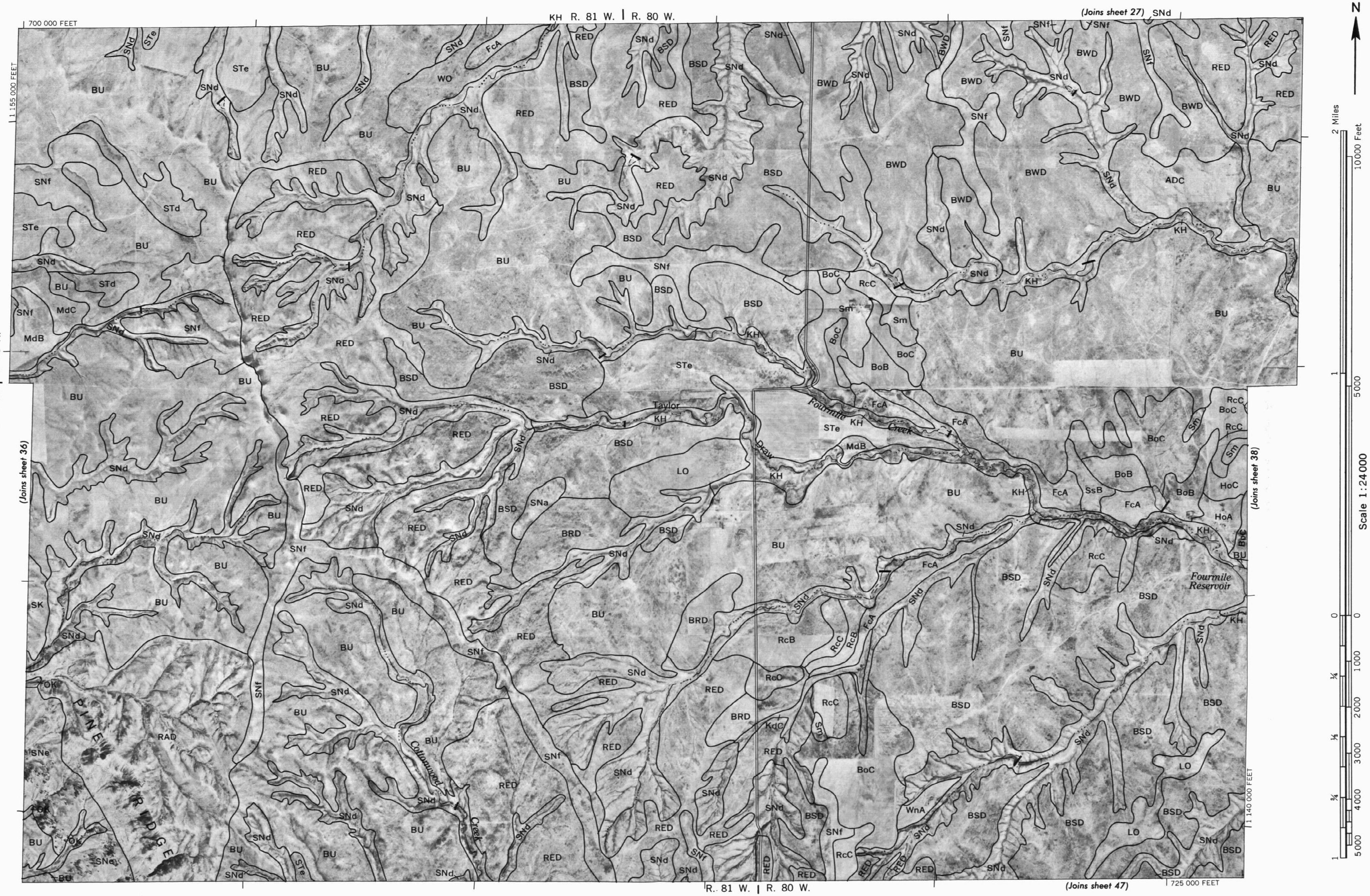
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

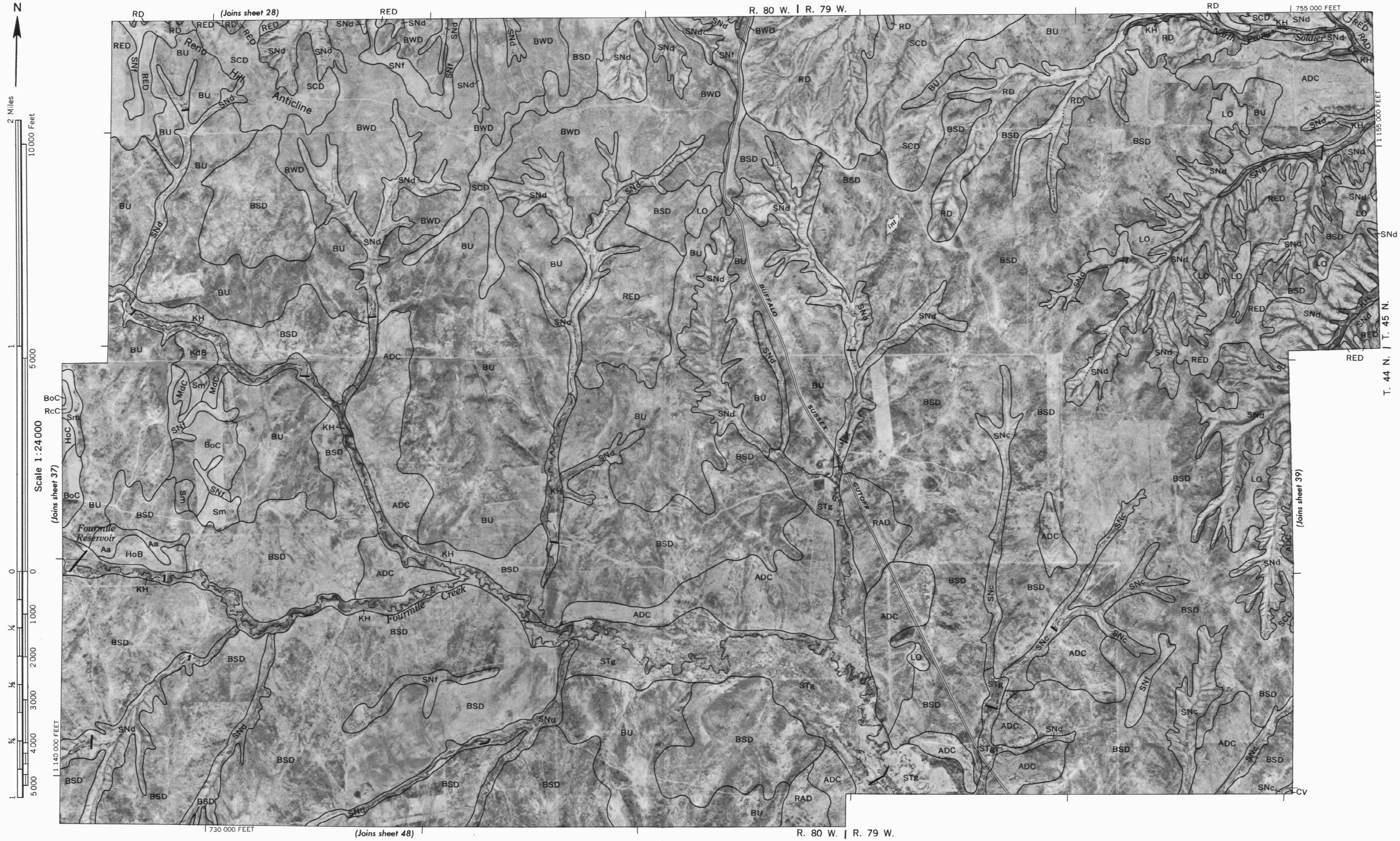


This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station. Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

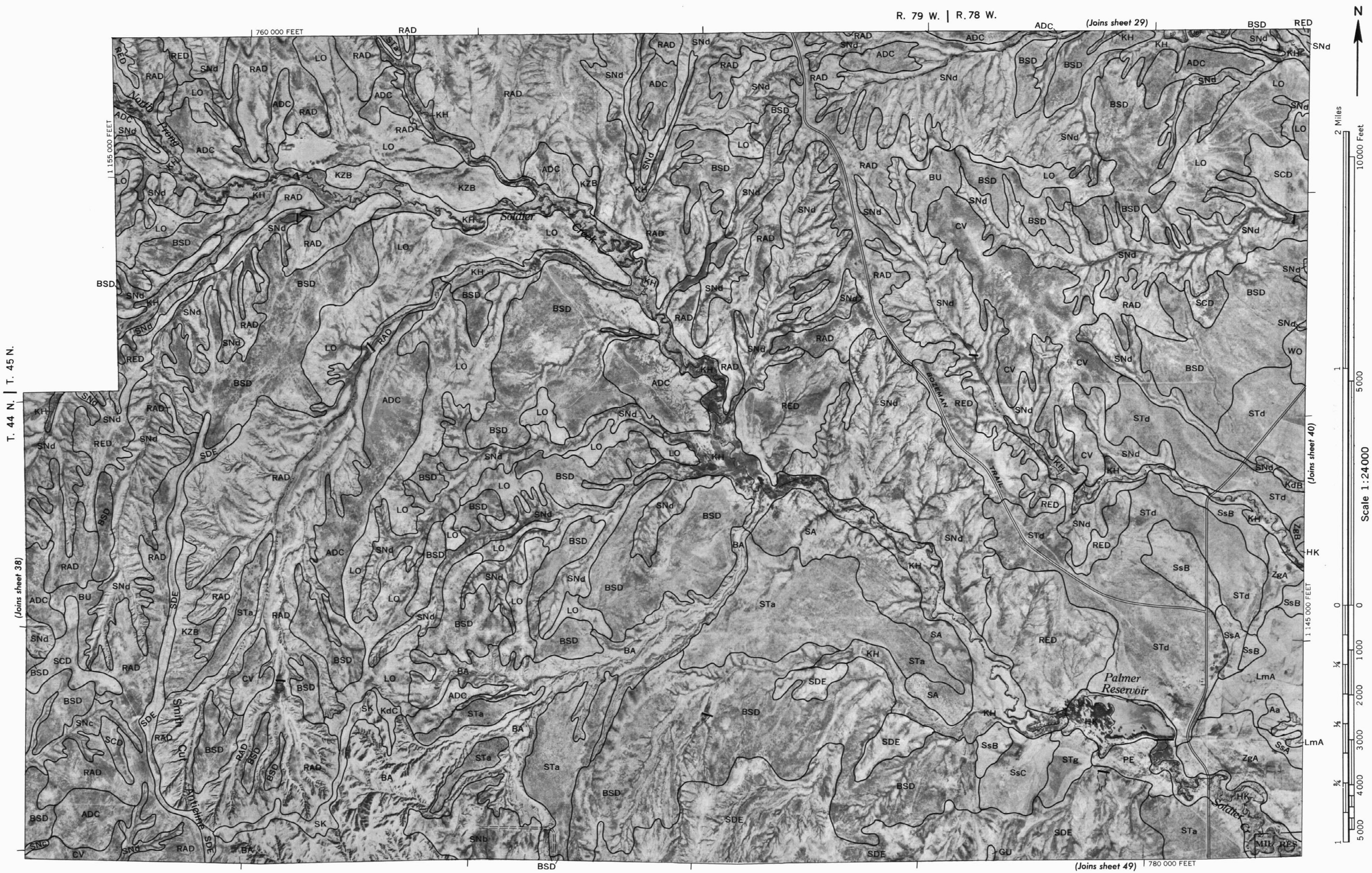
37



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

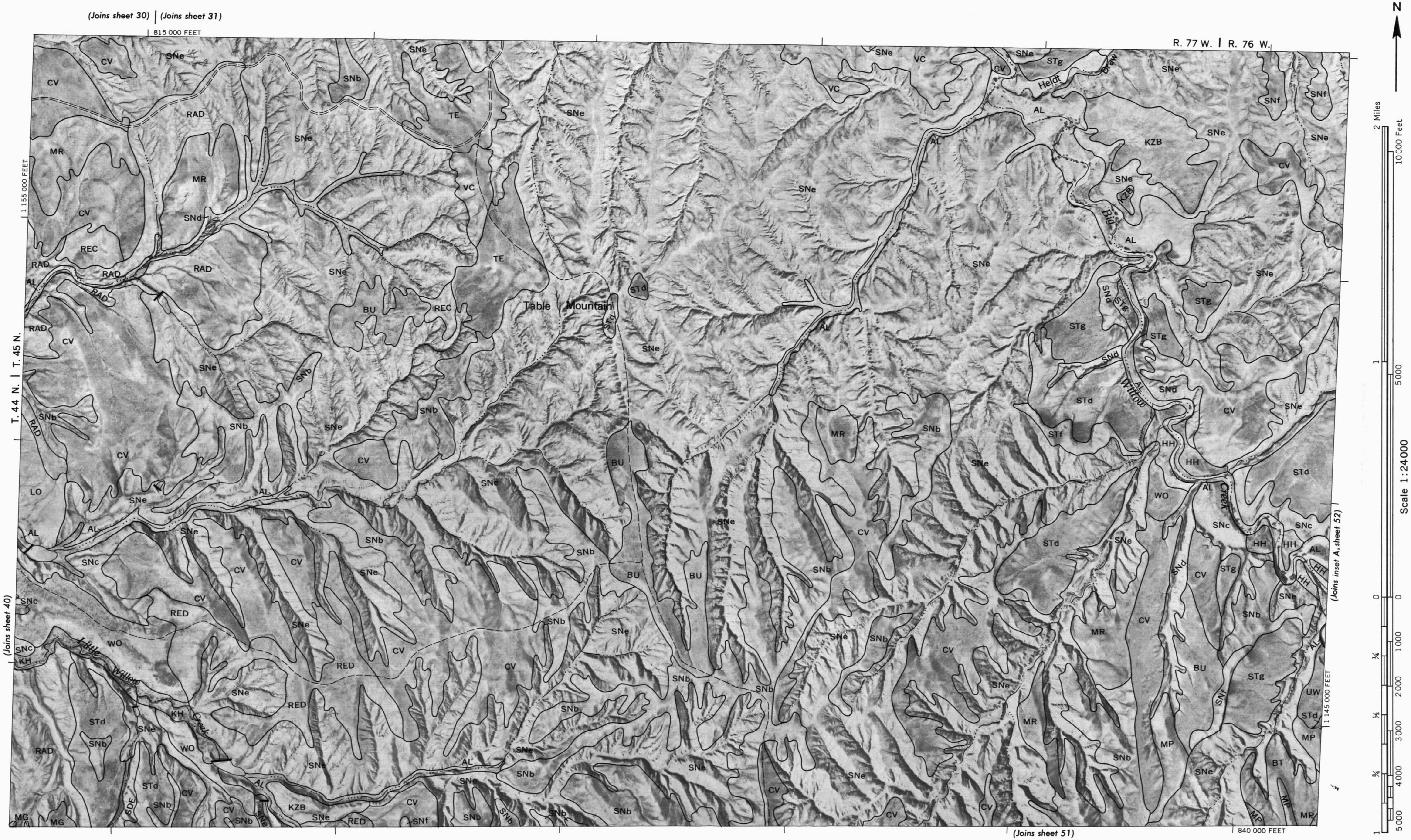

N
2 Miles
10 000 Feet
1
5000
0
0
1000
2000
3000
4000
5000
Scale 1:24000
(Joins sheet 28)
(Joins sheet 37)
(Joins sheet 39)
(Joins sheet 48)
R. 80 W. | R. 79 W.
T. 44 N. | T. 45 N.
755 000 FEET
1 155 000 FEET
1 140 000 FEET
730 000 FEET
Reno Hill Anticline
Fourmile Reservoir
Fourmile Creek
North Platte
Soldier
BUFFALO
SUSSEX
CUTOFF
Int.
RD
RED
SCD
SNd
SNf
SNc
BWD
BSD
BU
ADC
LO
KH
KdB
MdC
Sm
BoC
RcC
HoC
HoB
Aa
STg
RAD
CV

JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 39

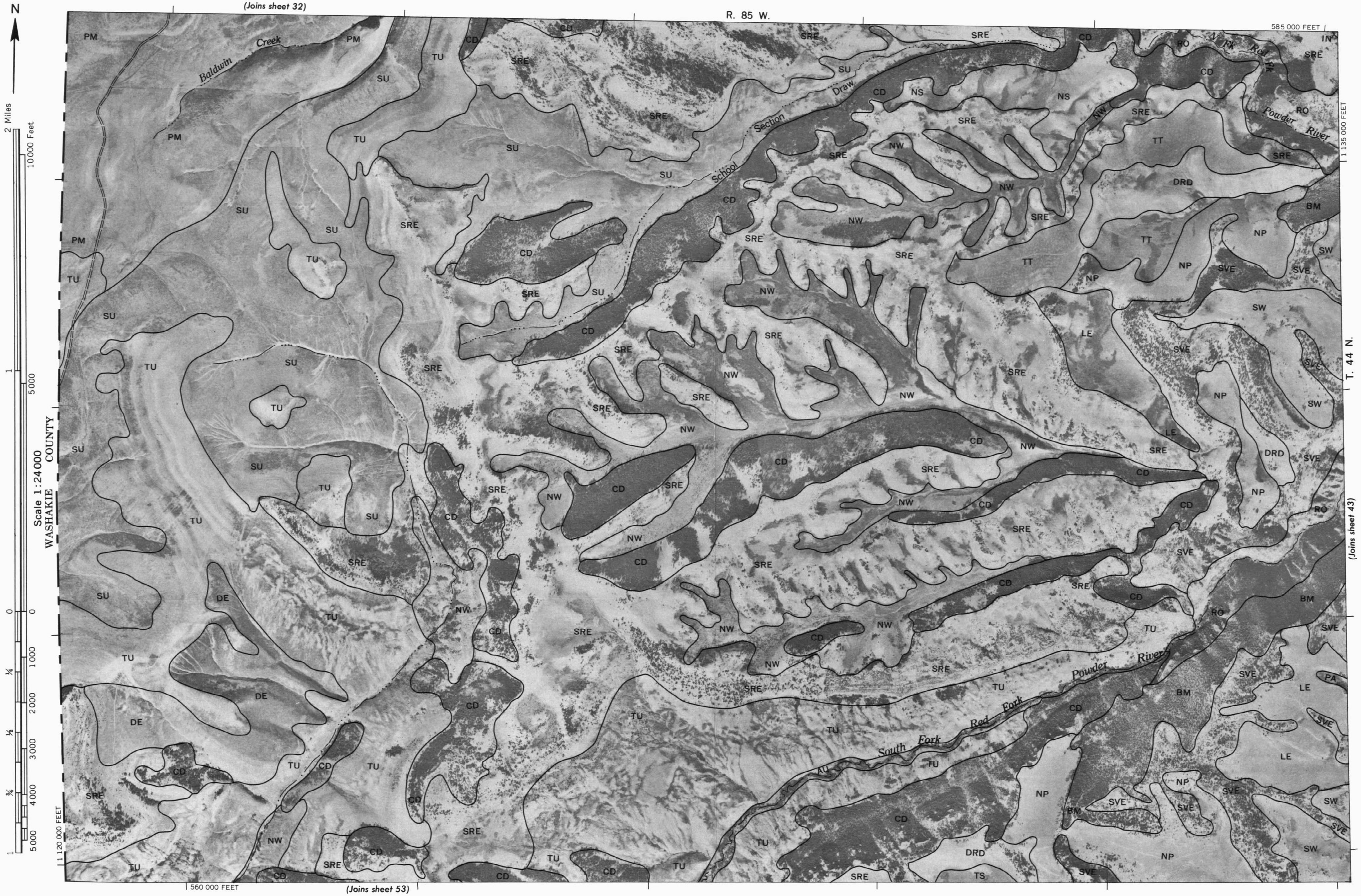


This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

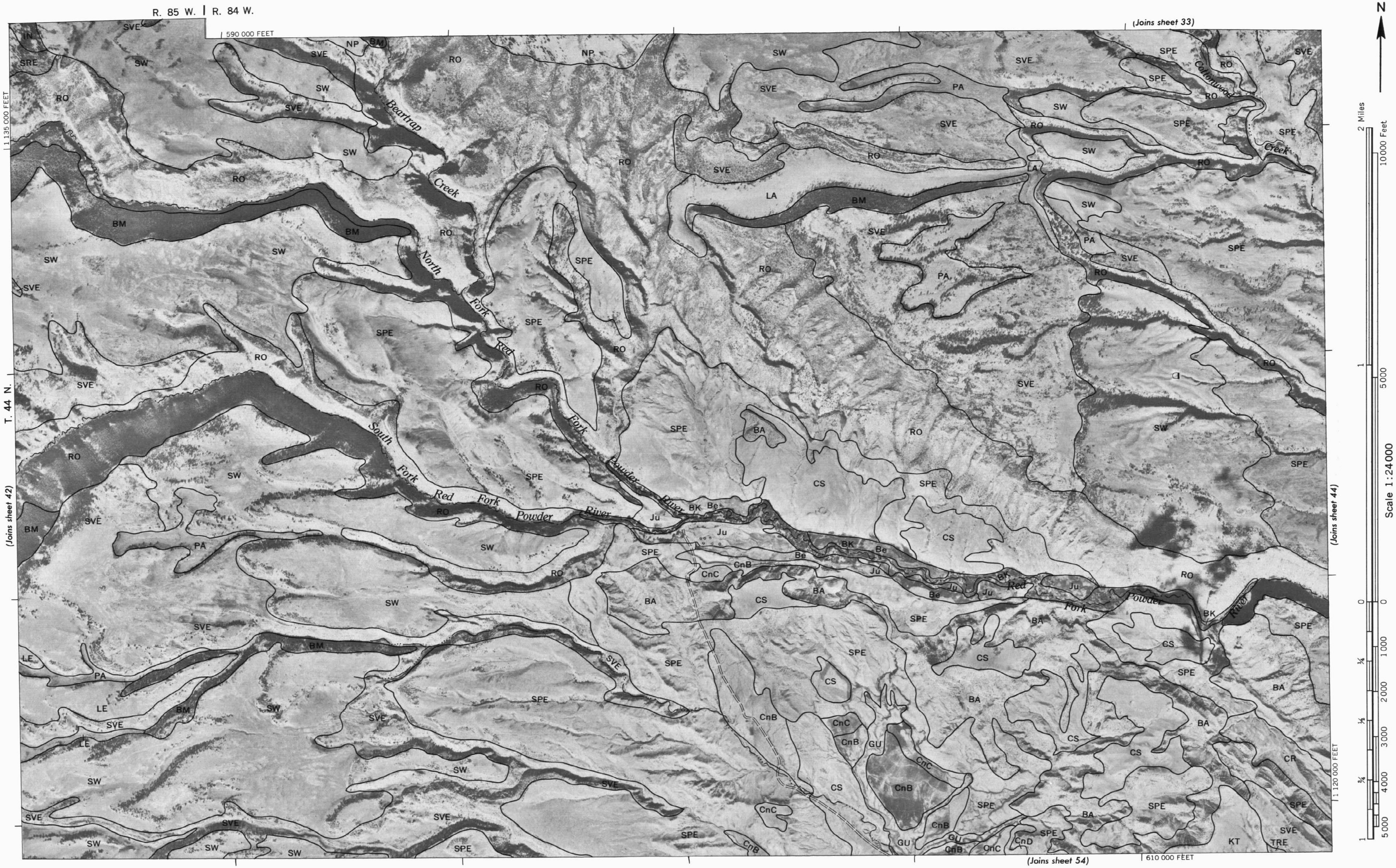


This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



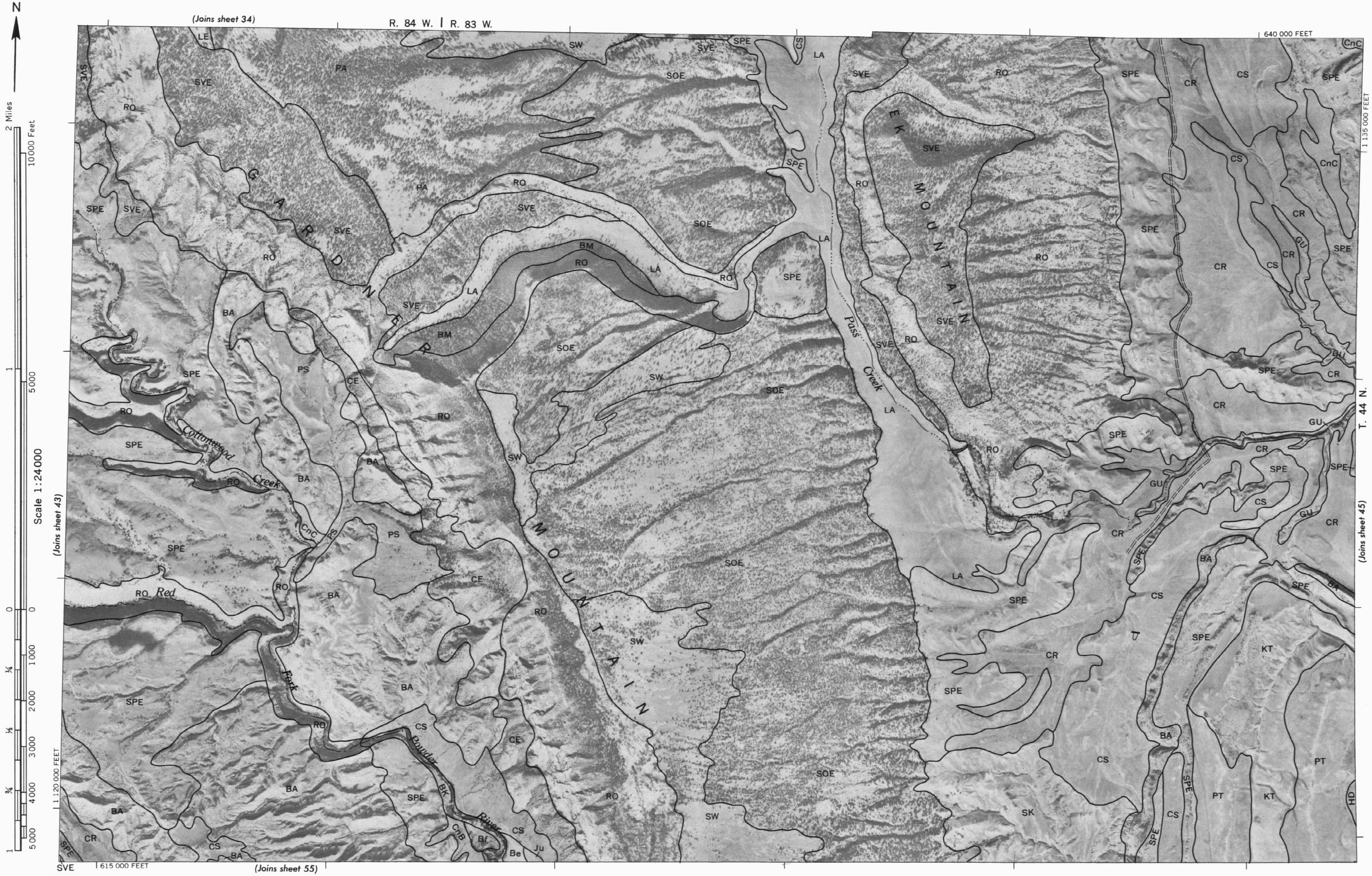
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.

Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

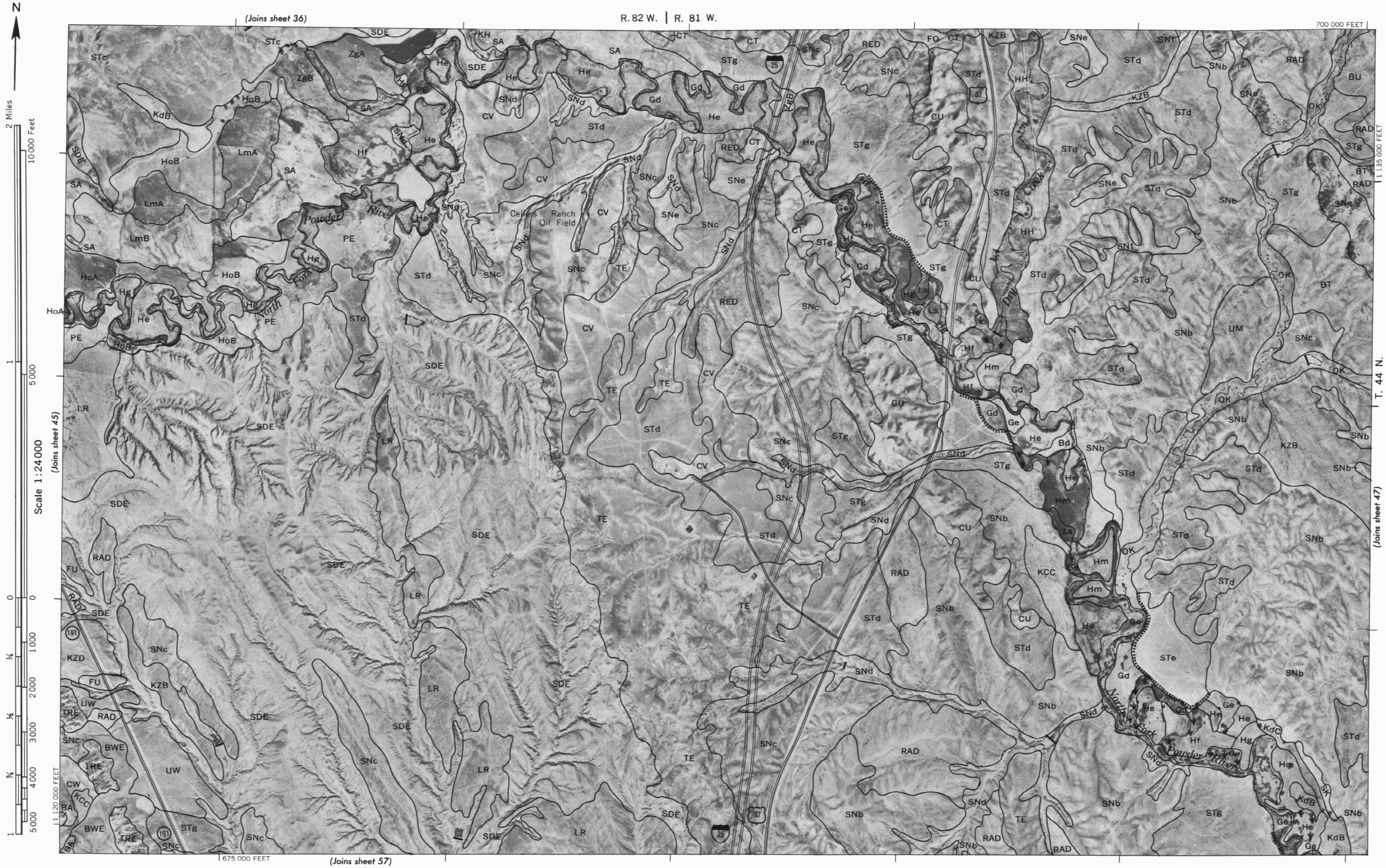
JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 44



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.


(Joins sheet 35)
(Joins sheet 44)
(Joins sheet 46)
(Joins sheet 56)
R. 83 W.
R. 82 W.
T. 44 N.
645 000 FEET
670 000 FEET
1 135 000 FEET
1 120 000 FEET
N
Scale 1:24000
2 Miles
10 000 Feet
North
Fork
Pass
Creek
Powder
River
G.P.
191
KT
SVE
MTD
SDE
KCC
RM
RO
SPE
CnC
SK
KZD
LnB
Aa
Be
ZgB
Hg
BK
Hf
Hm
He
Ge
HoA
PE
STc
Ha
LO
LmB
SA
Pc
ZgA
LmA
Gd
Bf
Ht
ADC
HoC
HoB
STg
LR
TRE
ZKD
RND
MV
KdC
CR
BA
CS
HD
PT
SH
CW
SNc
UW
BWE
RAD
FU
WC
WE

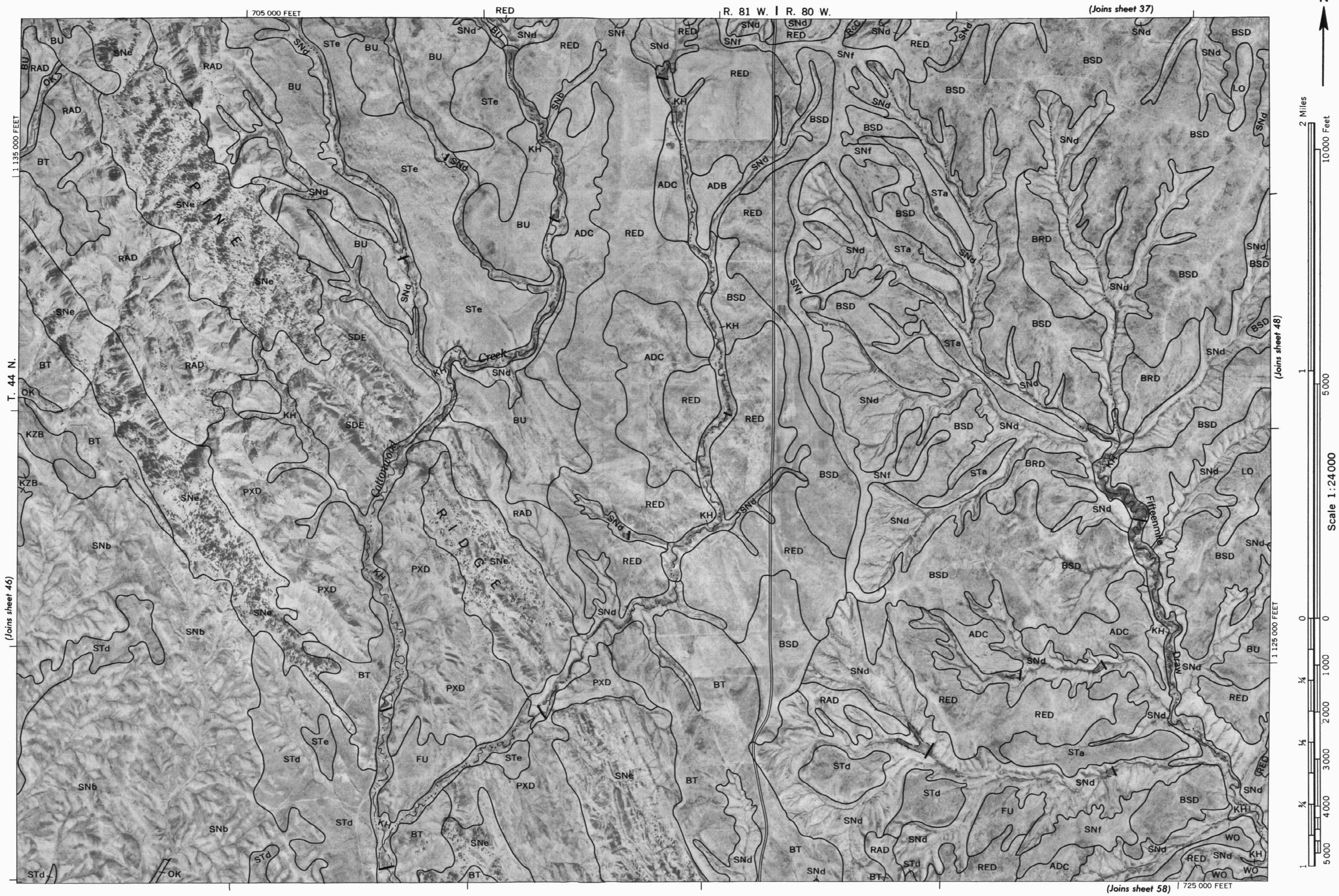
JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 46



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 47

47

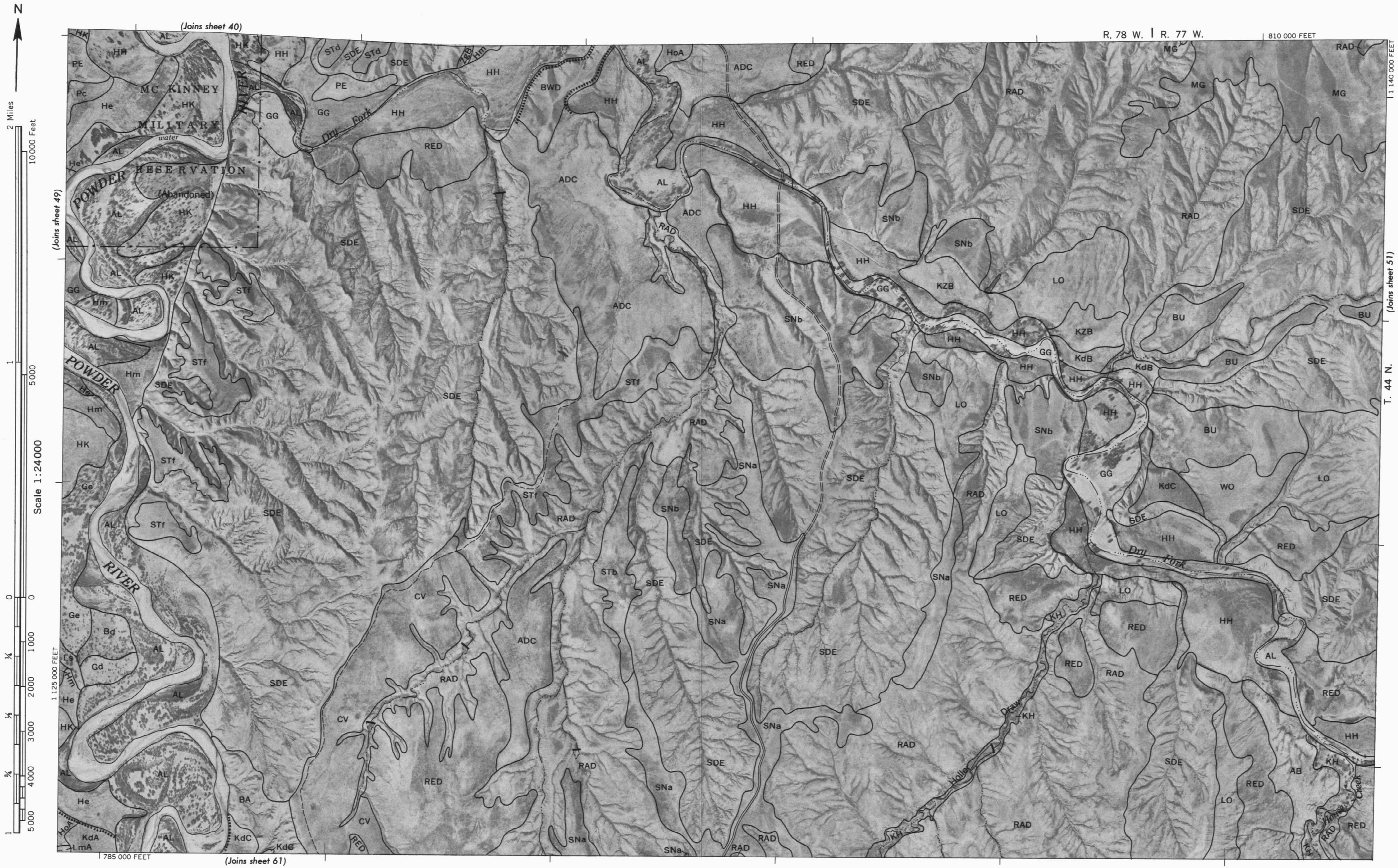


This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 48

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station. Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

(Joins sheet 41)

R. 77 W. | R. 76 W.

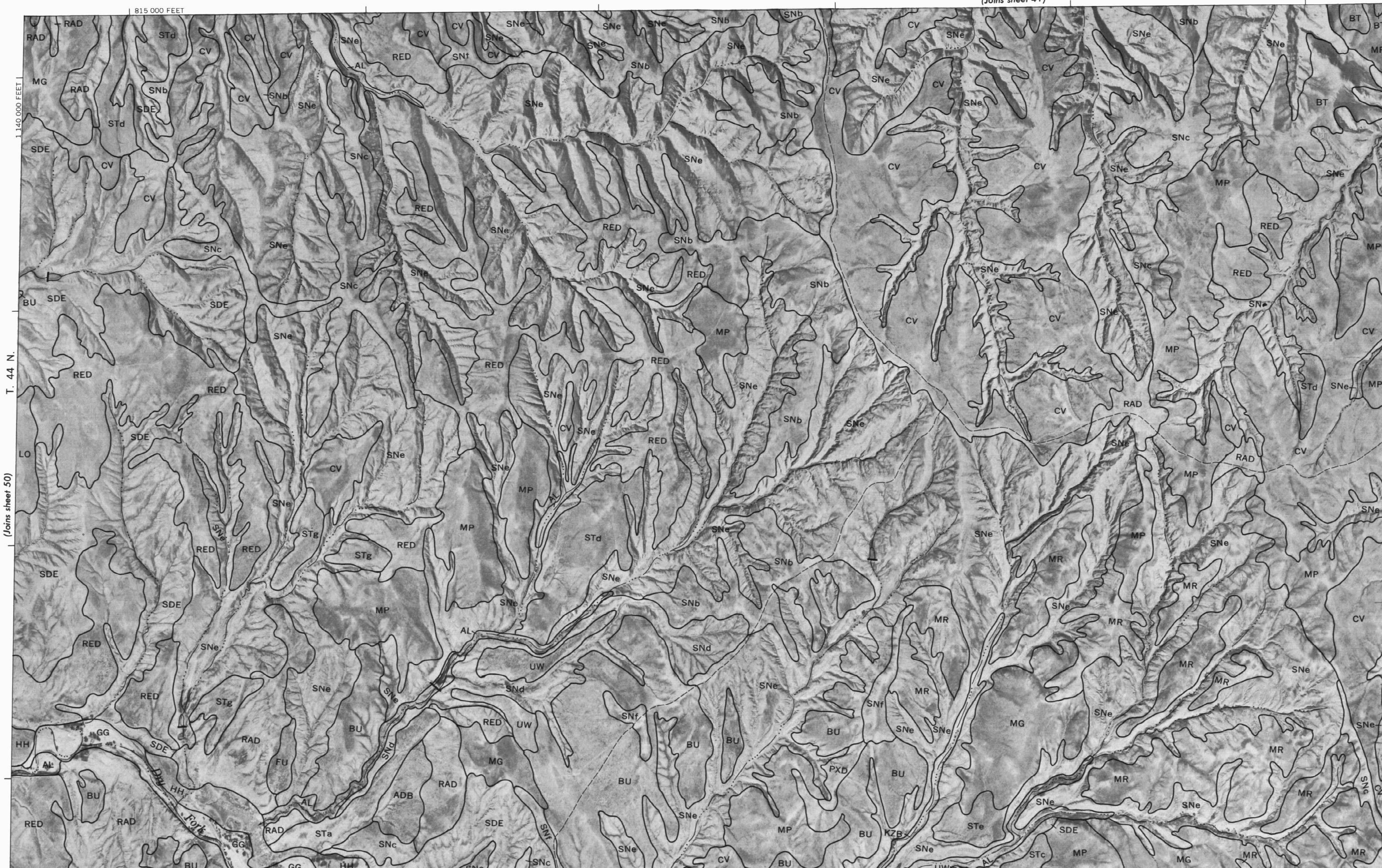
N

815 000 FEET

1 140 000 FEET

T. 44 N.

(Joins sheet 50)



(Joins sheet 52)

1 125 000 FEET

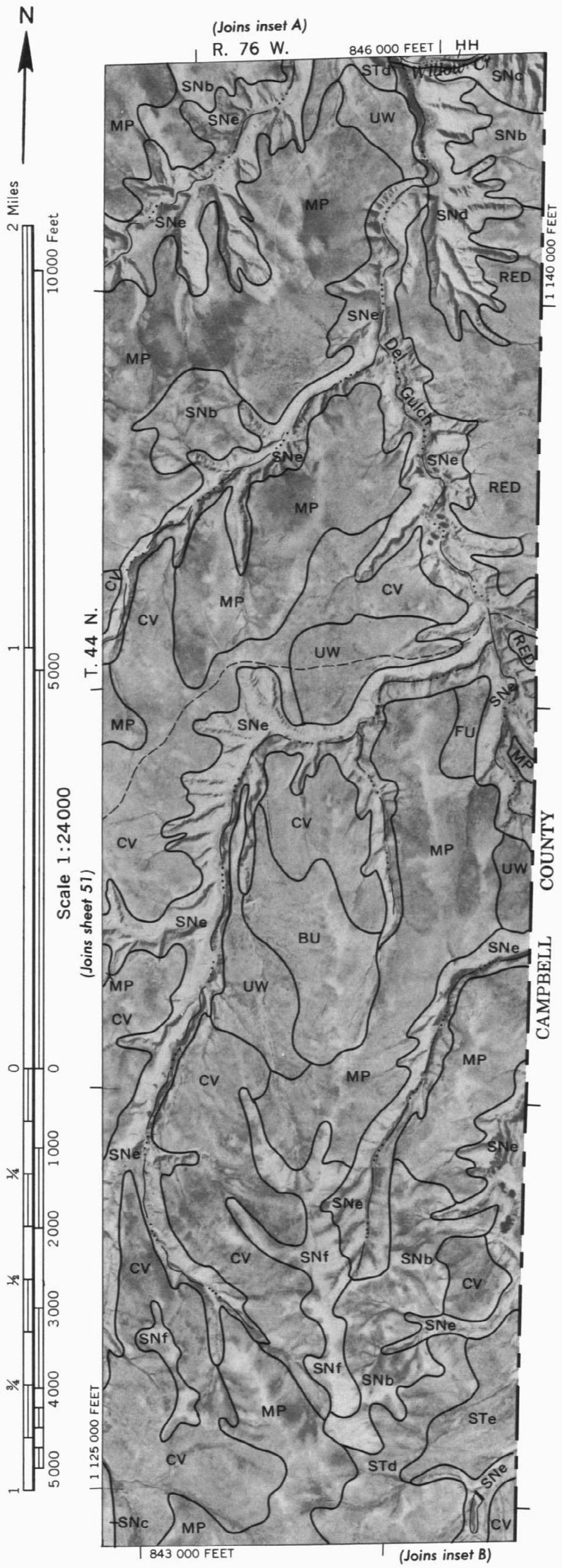
840 000 FEET

(Joins sheet 62)

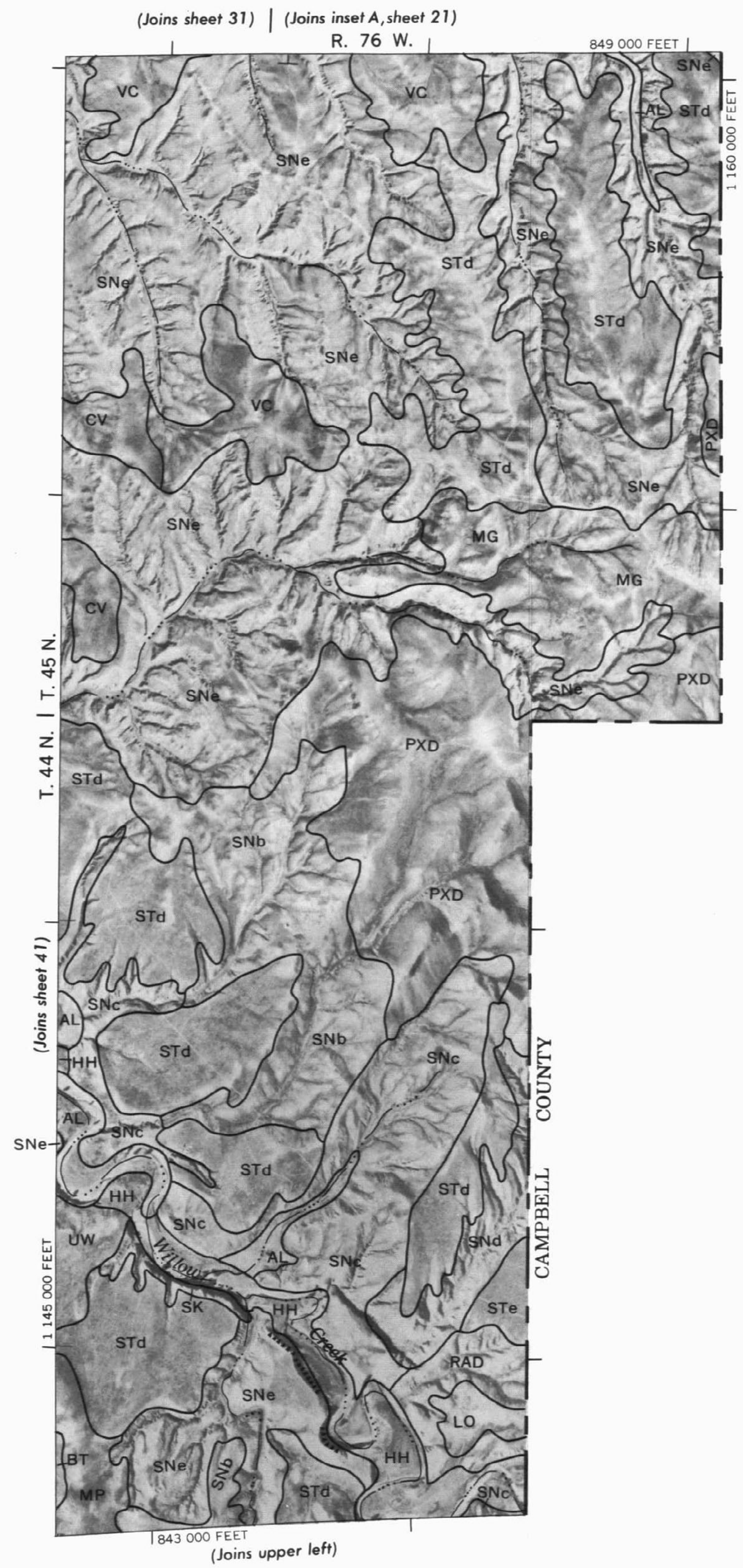
2 Miles
1
¾
½
¼
0

10 000 Feet
5000
1000
2000
3000
4000
5000
0

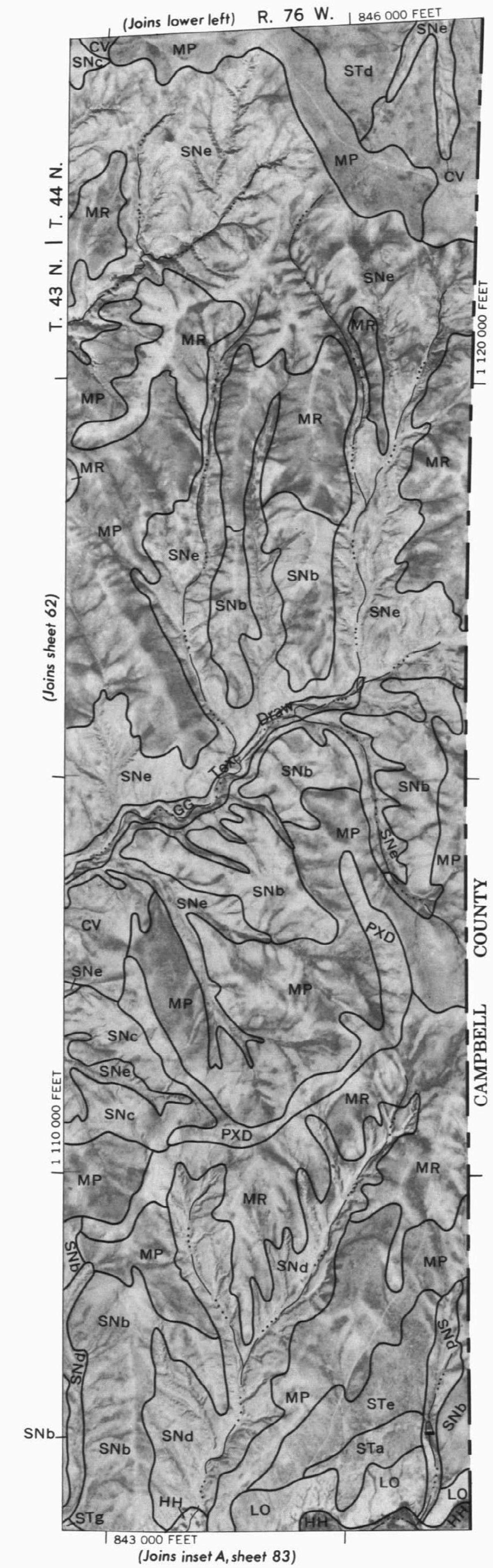
Scale 1:24000



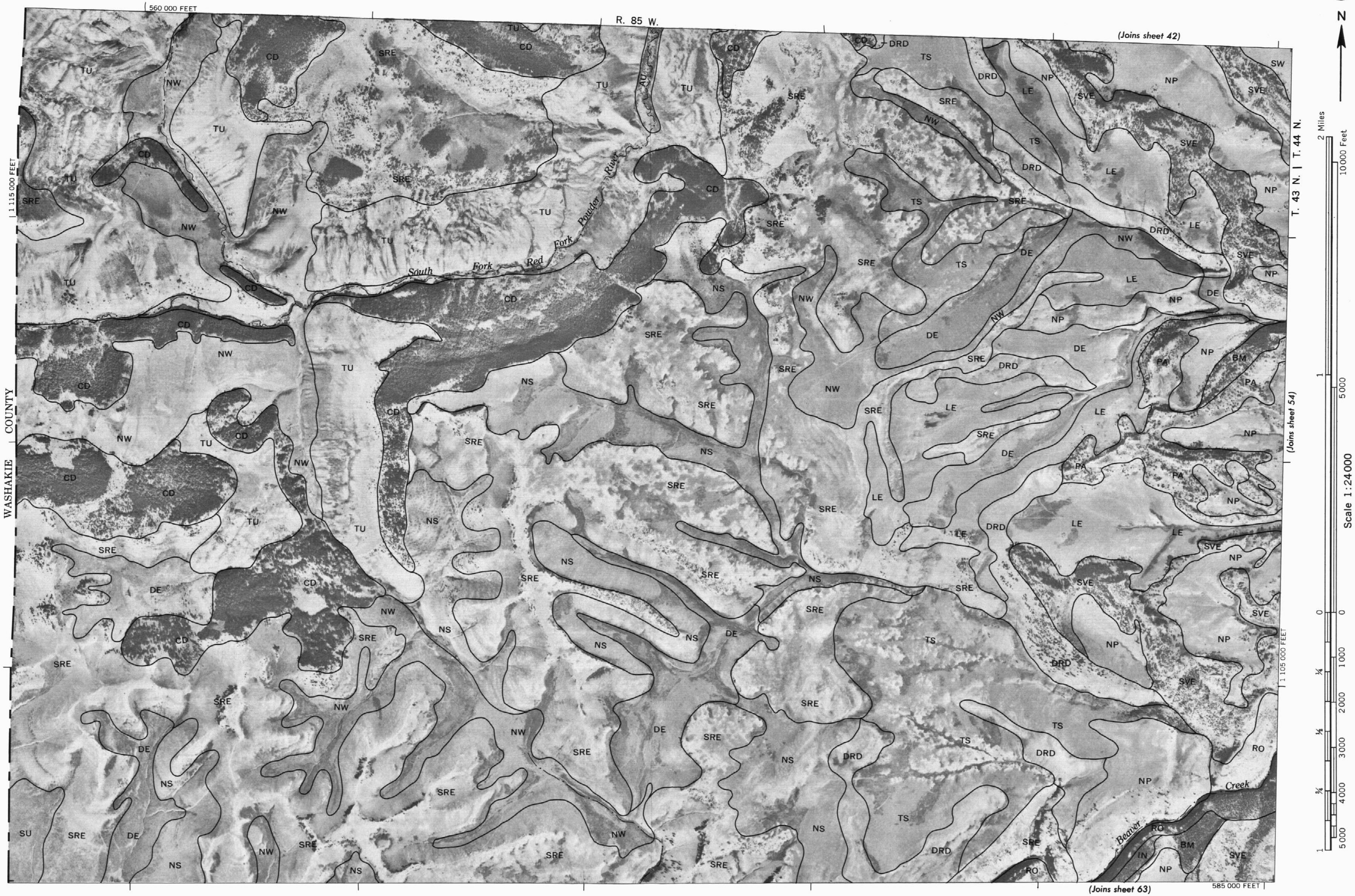
INSET A



INSET B

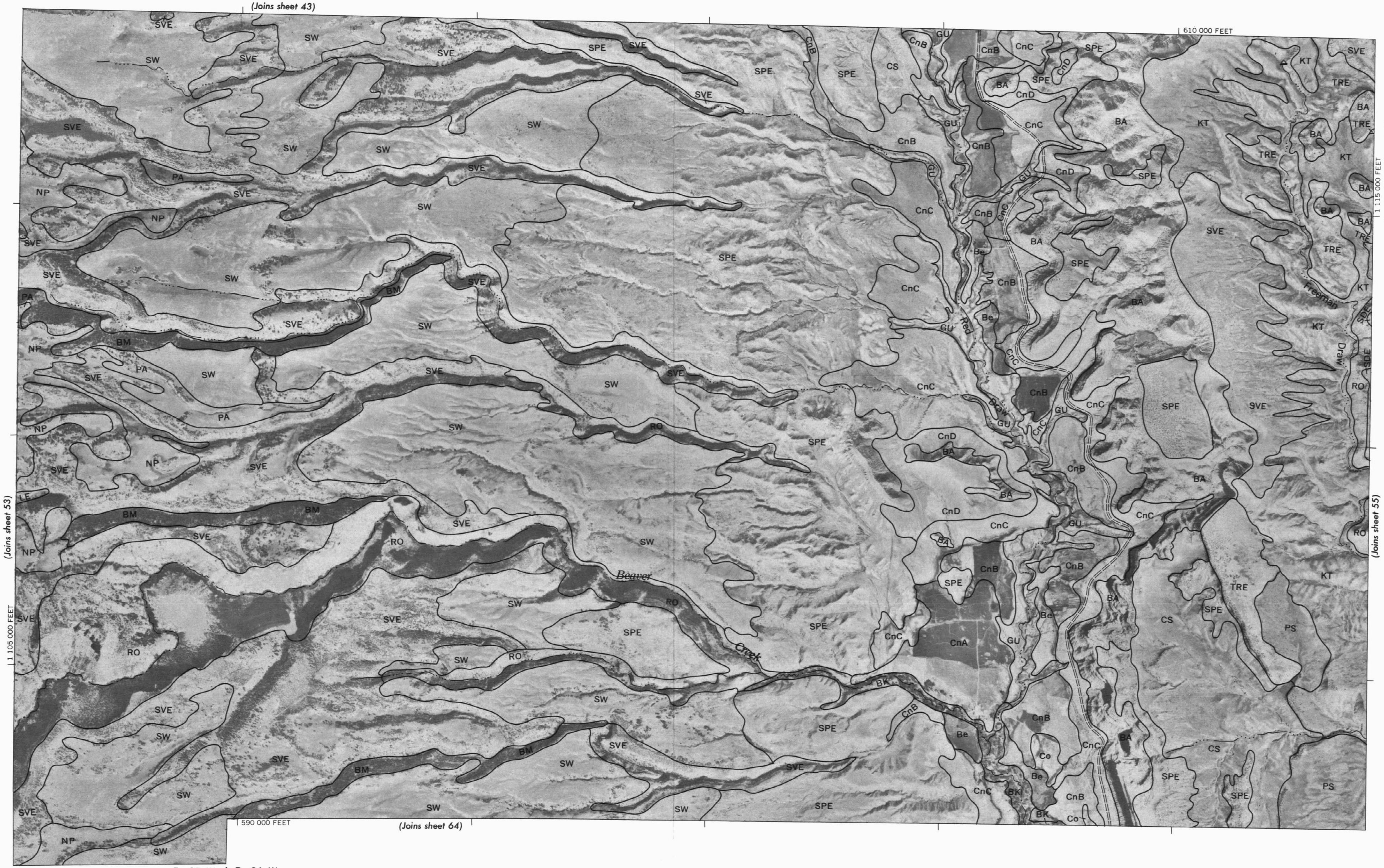


This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 54



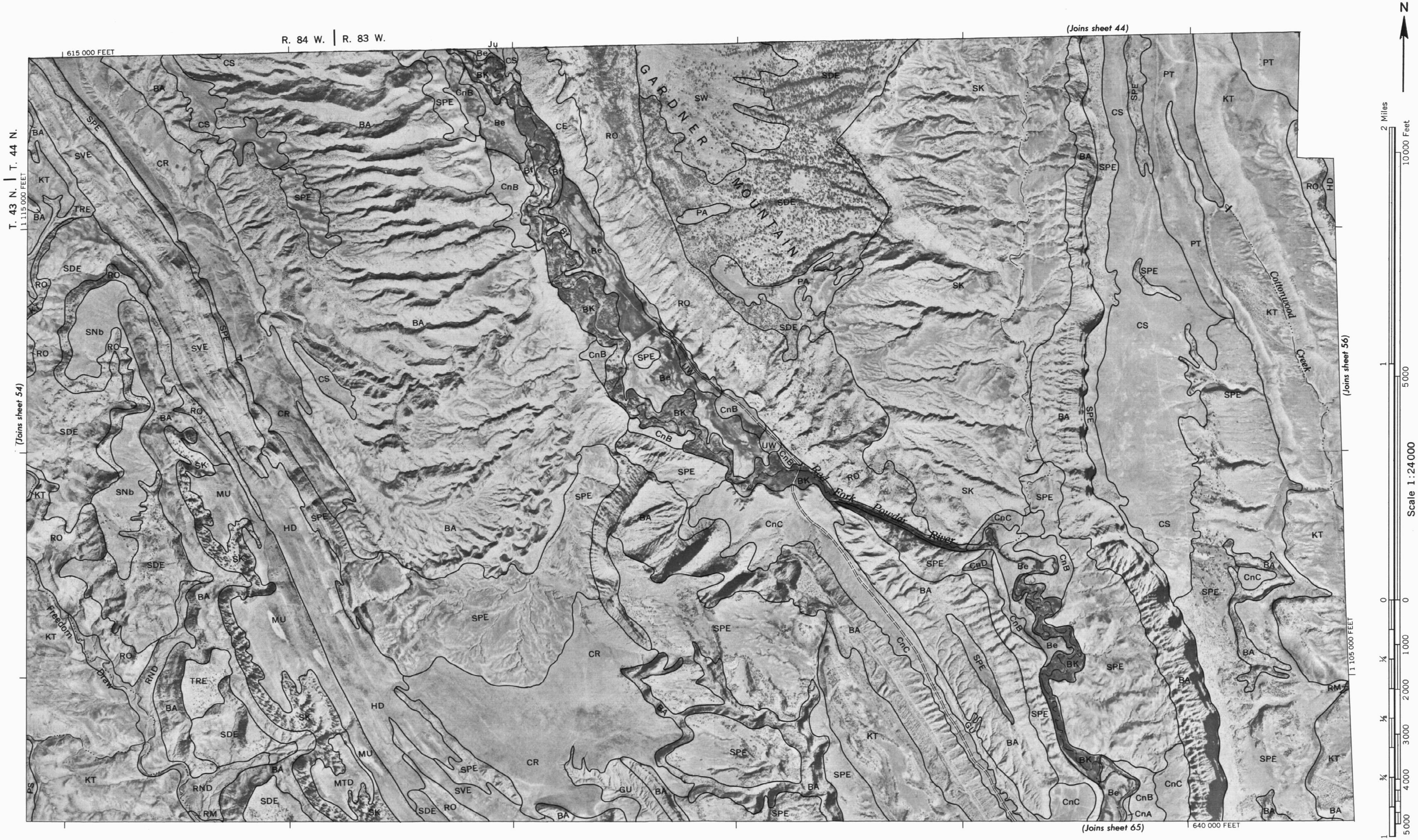
N

Scale 1:24 000

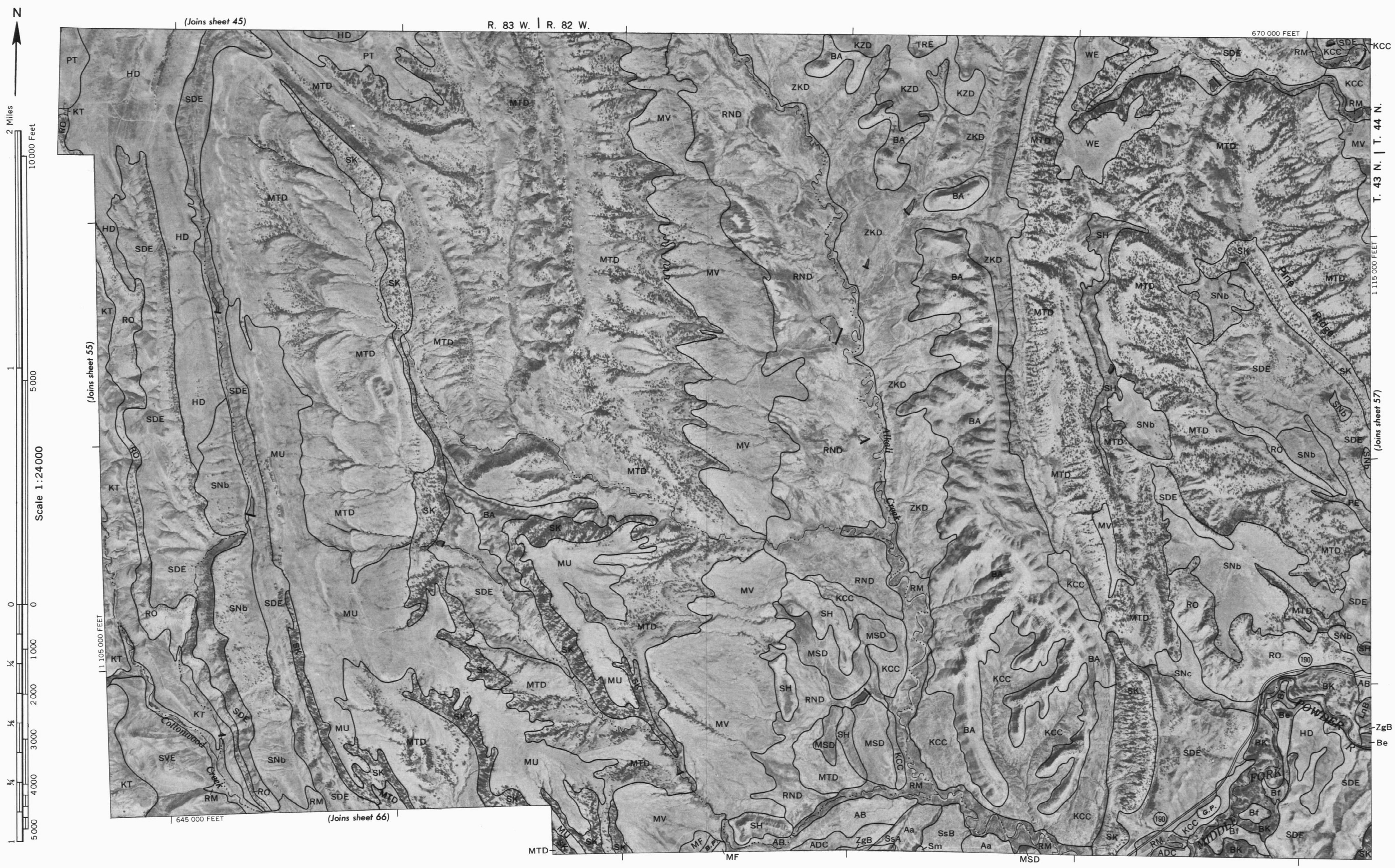
2 Miles | 1 | 0 | ¼ | ½ | ¾ | 1

10 000 Feet | 5000 | 0 | 1000 | 2000 | 3000 | 4000 | 5000

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



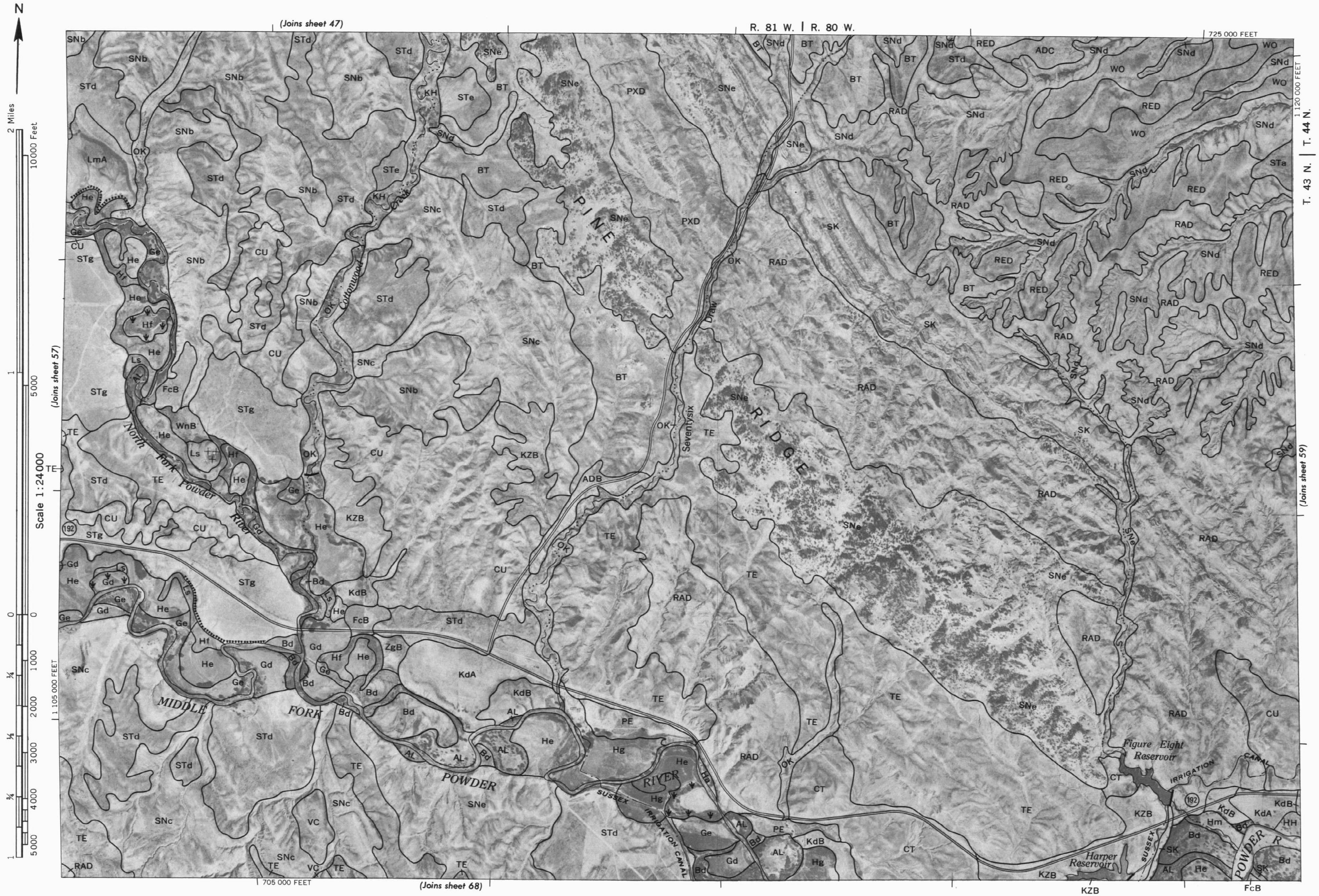
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

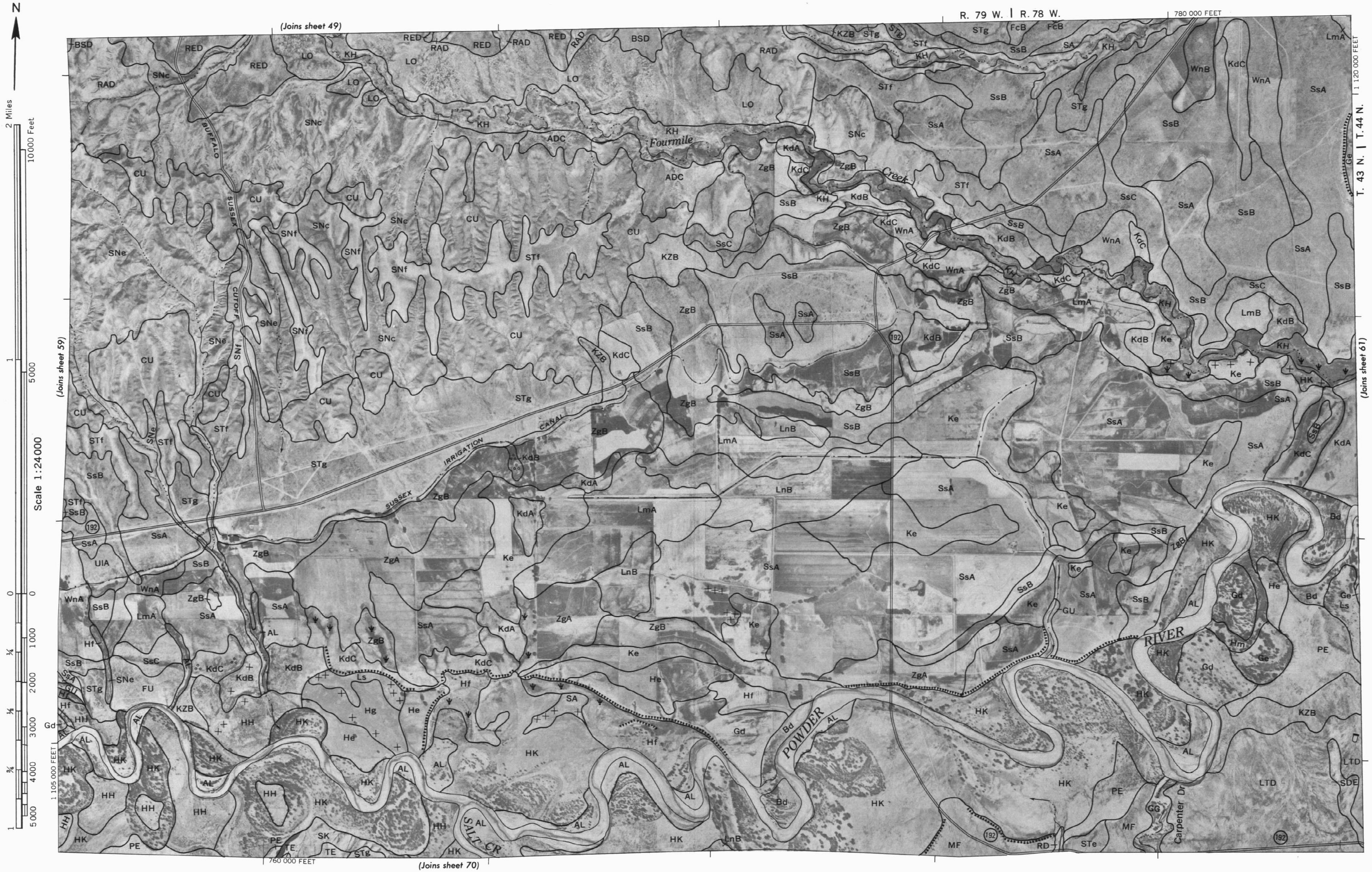
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 58



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

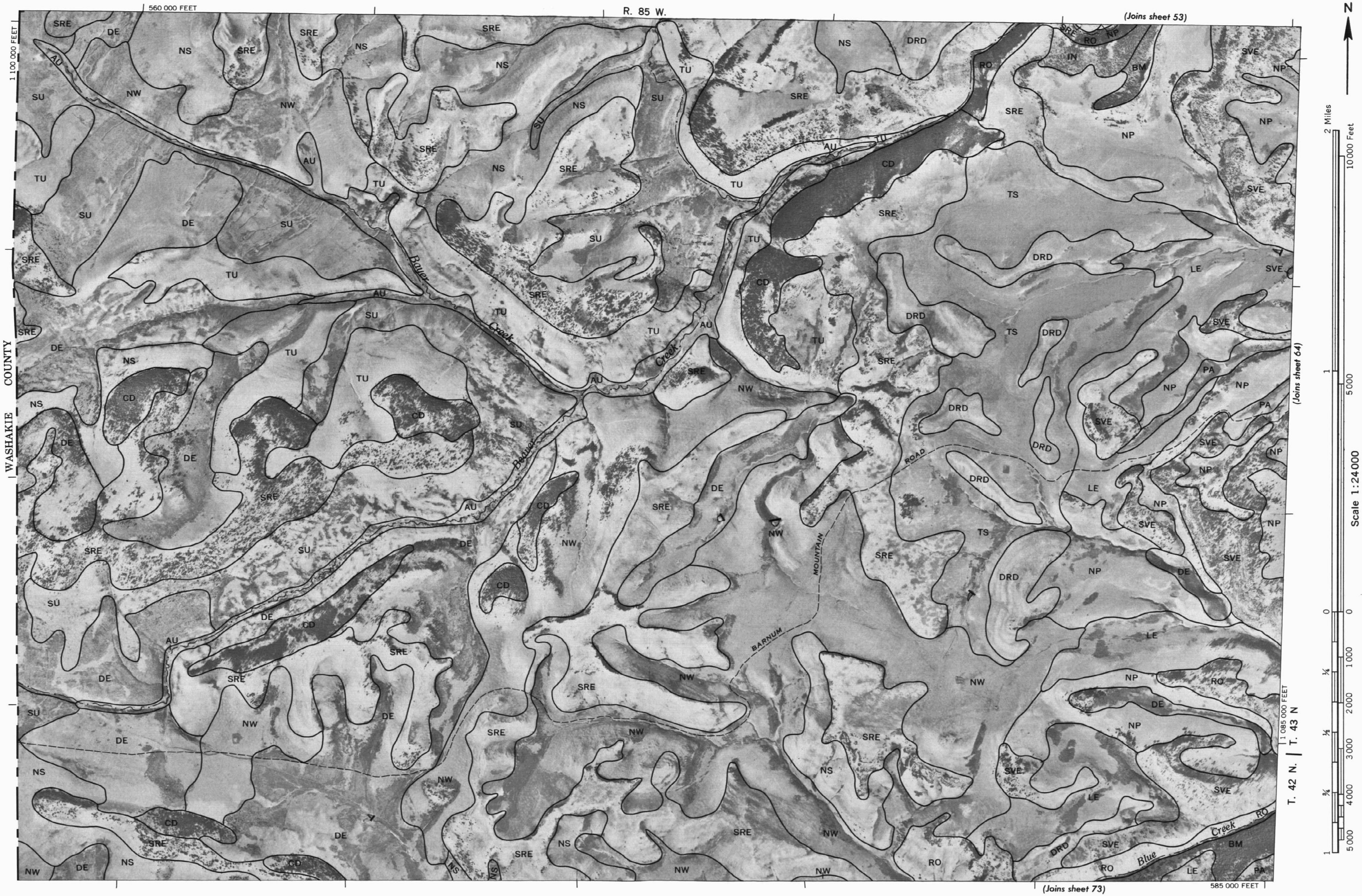


This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

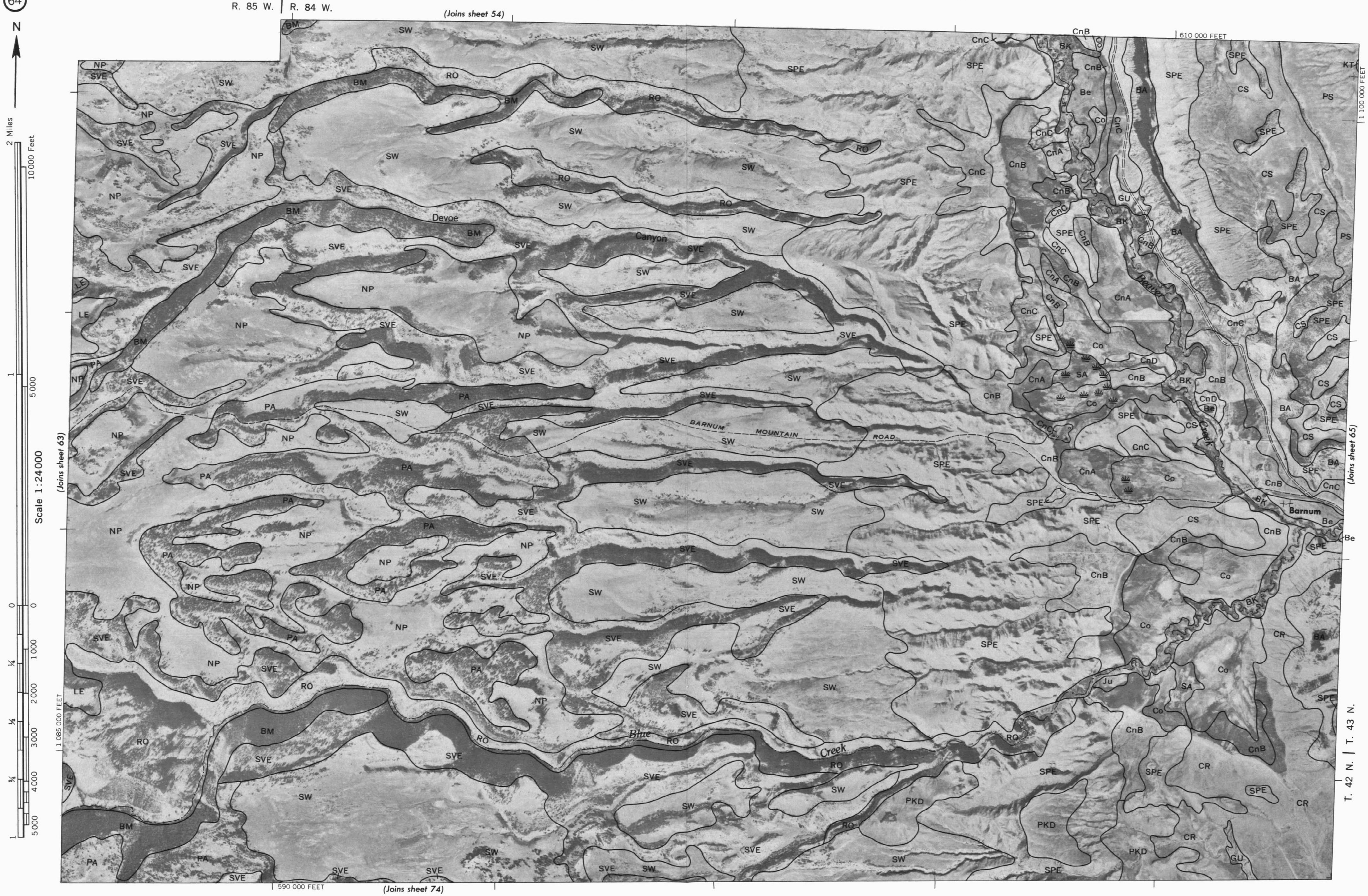
JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 62

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

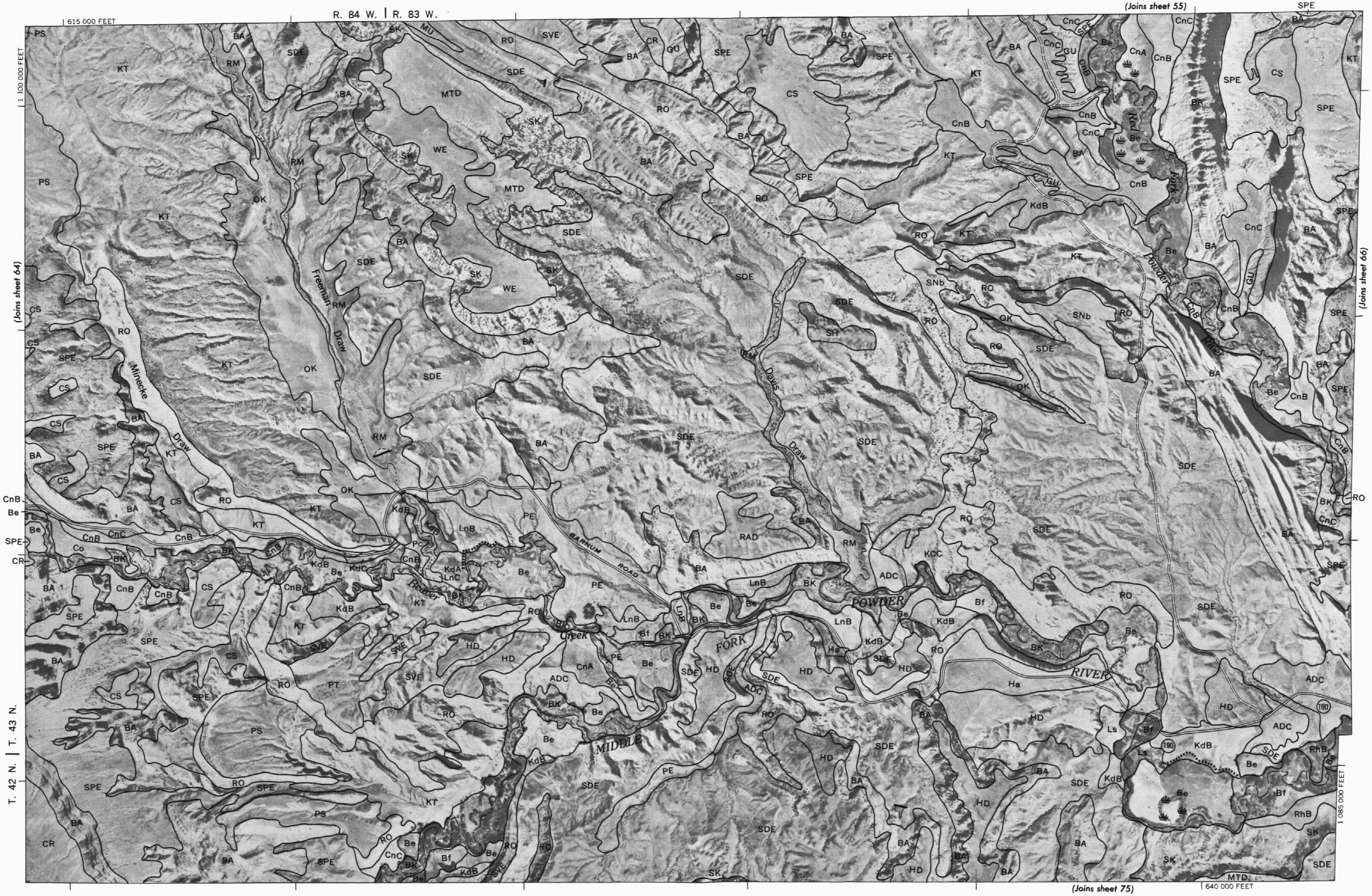


This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 64



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



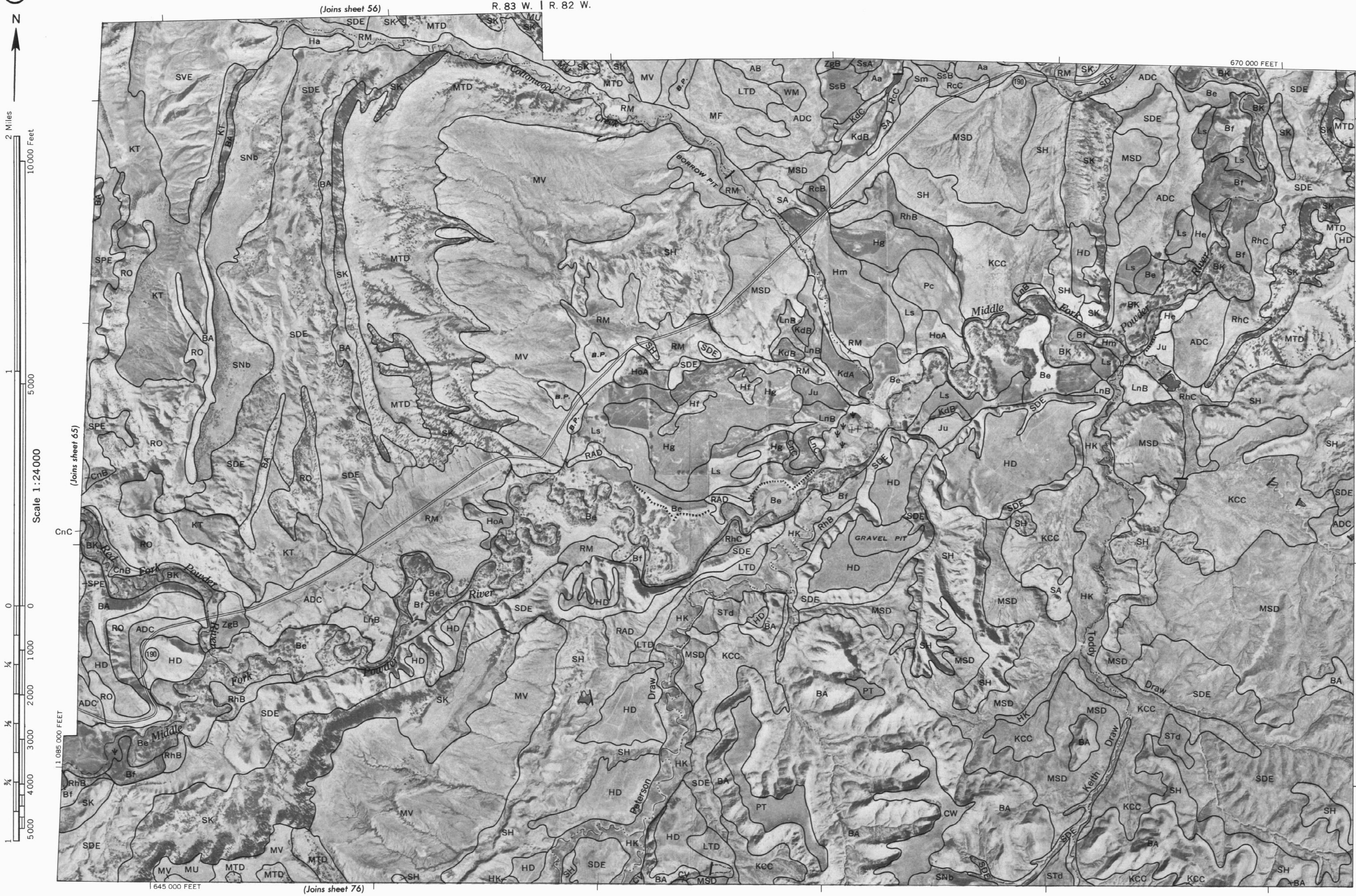
N

Scale 1:24000

2 Miles | 1 | 0 | ¼ | ½ | ¾ | 1

10 000 Feet | 5000 | 0 | 1000 | 2000 | 3000 | 4000 | 5000

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

R. 82 W. | R. 81 W.

675 000 FEET

(Joins sheet 57)

1 100 000 FEET

(Joins sheet 66)

(Joins sheet 68)

SDE

1 085 000 FEET

700 000 FEET

(Joins sheet 77)

SNc

T. 42 N. | T. 43 N.

N

Scale 1:24000

2 Miles | 1 | ¾ | ½ | ¼ | 0 | 1

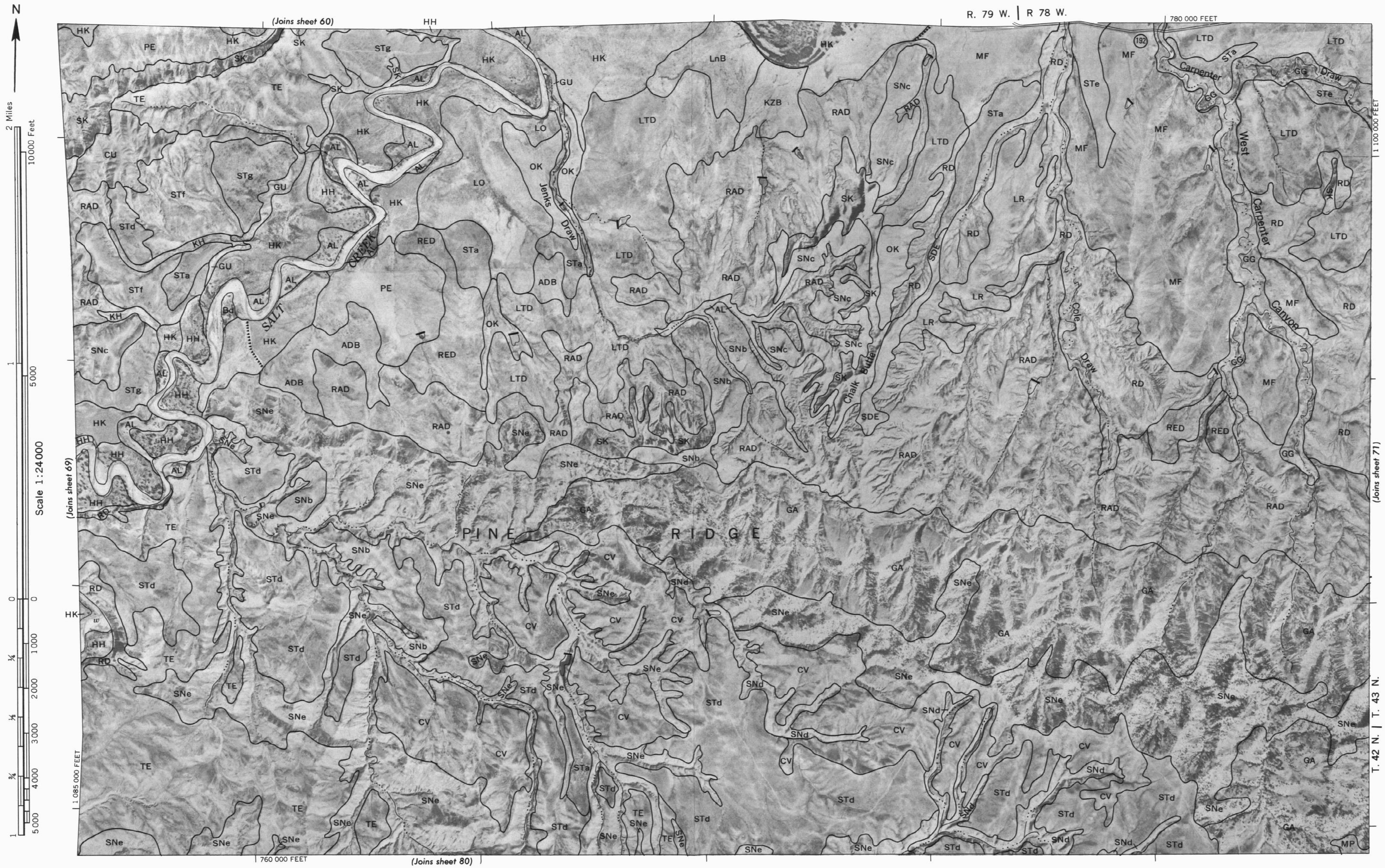
10000 Feet | 5000 | 0 | 1000 | 2000 | 3000 | 4000 | 5000

This map is one of set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

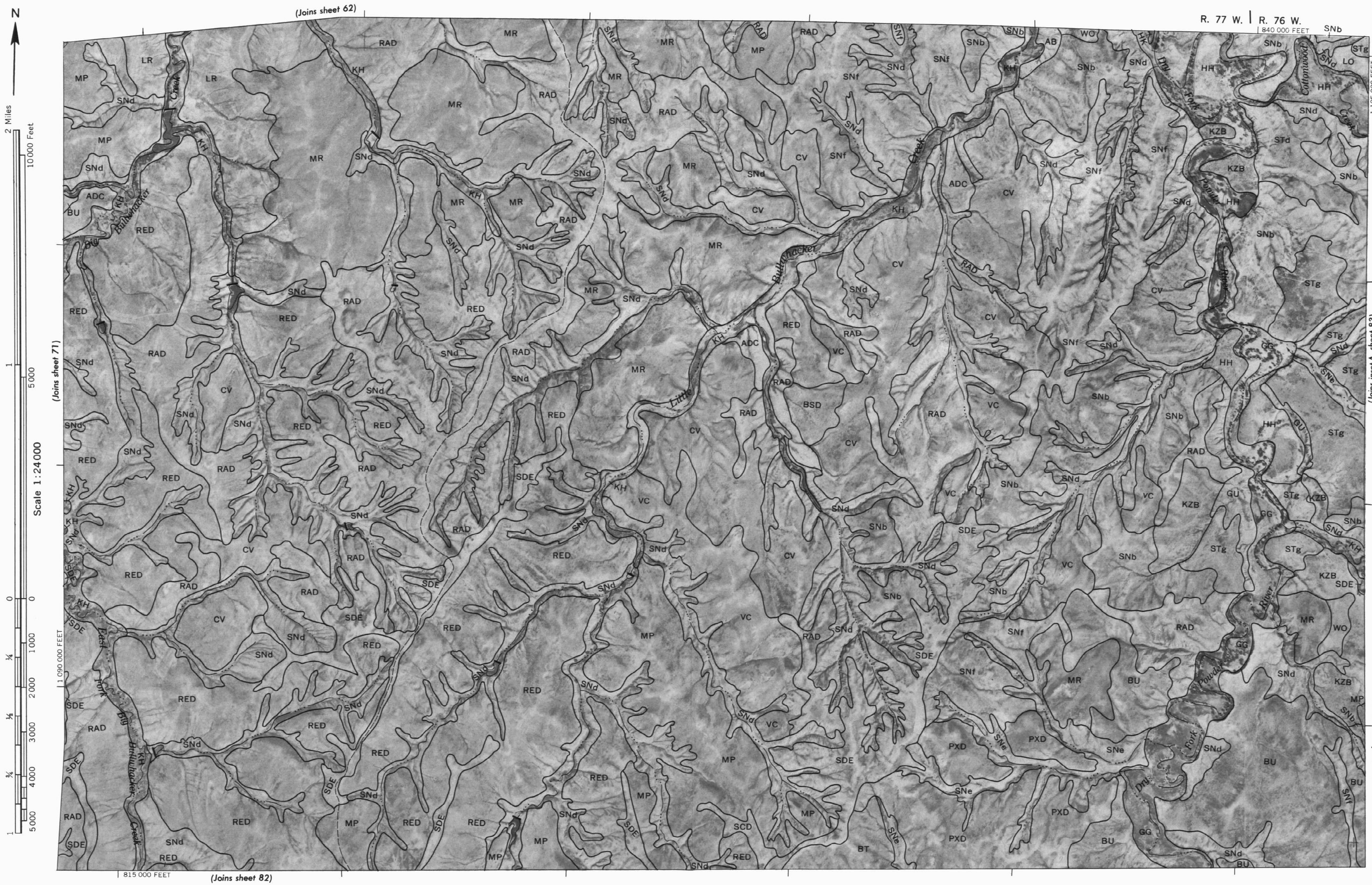
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 70

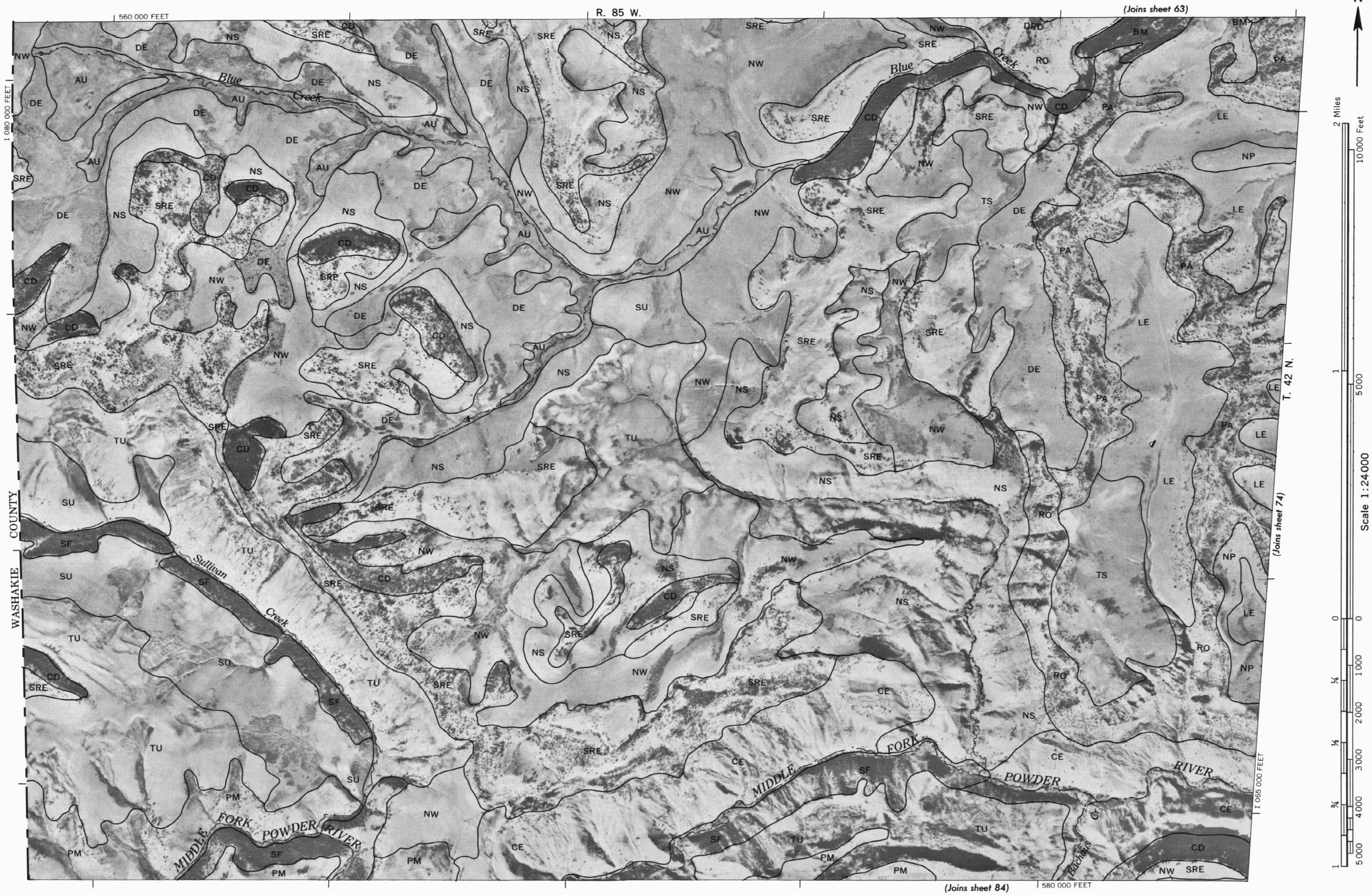


This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

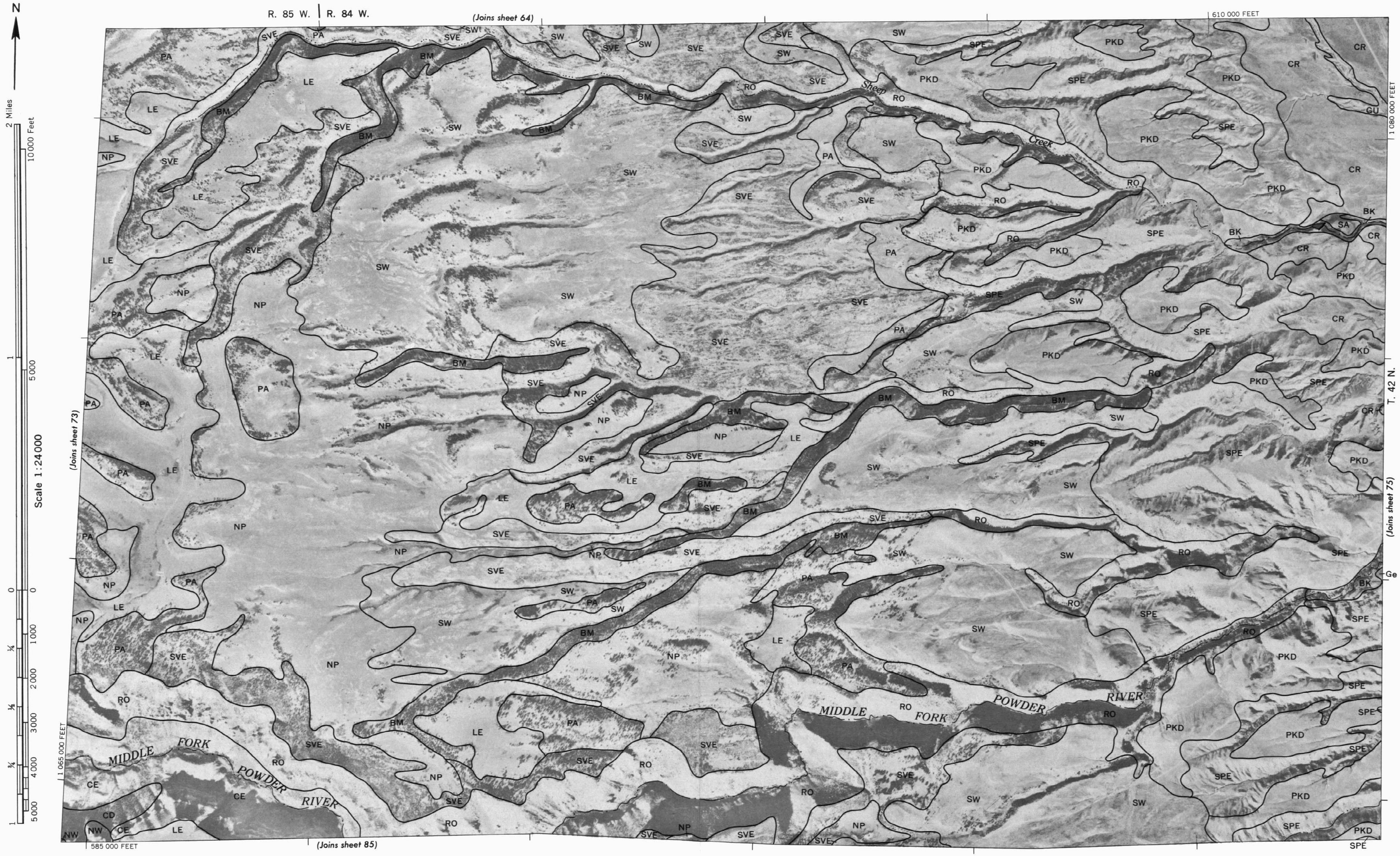


This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 74



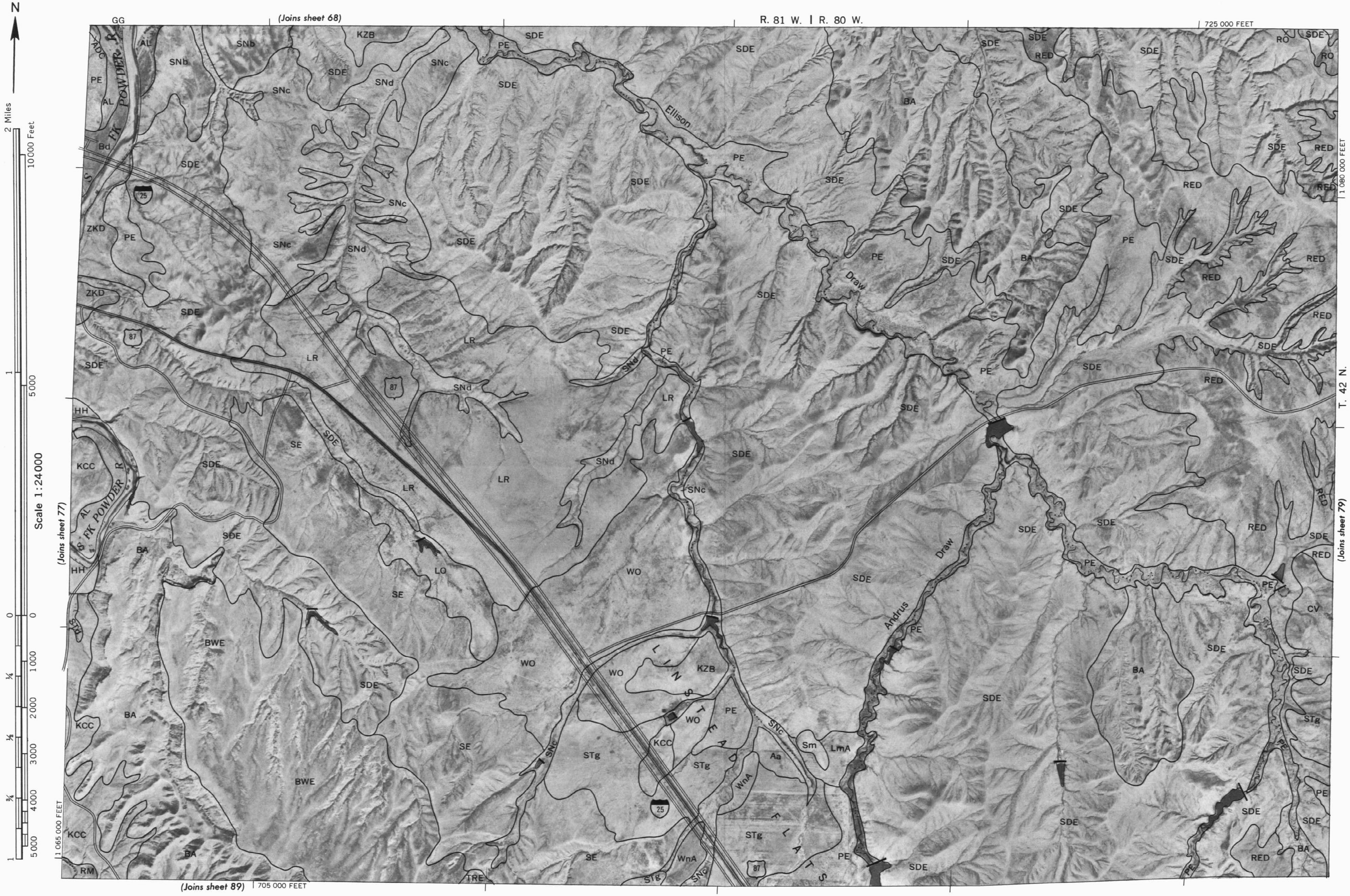
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

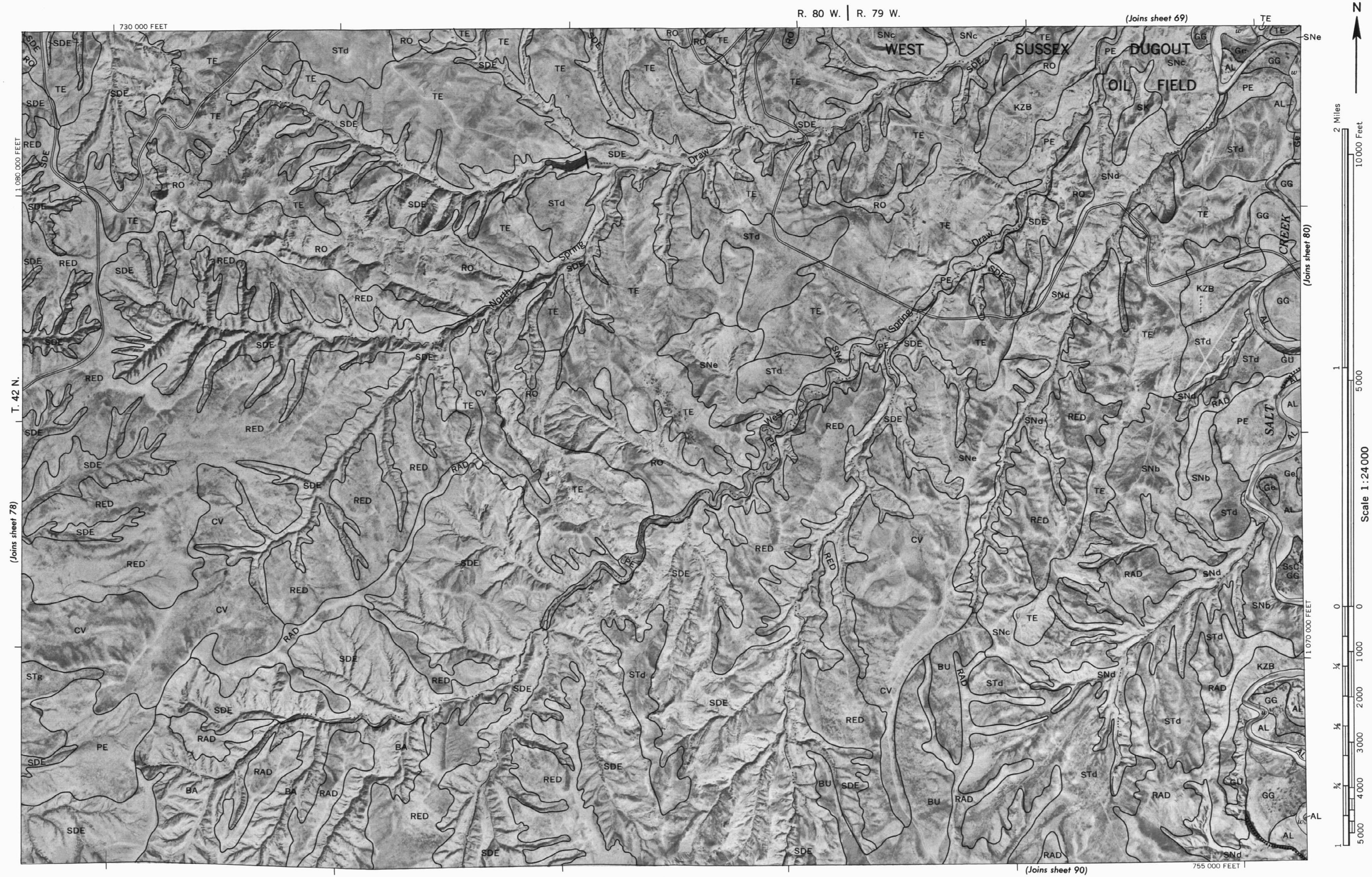
JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 76

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

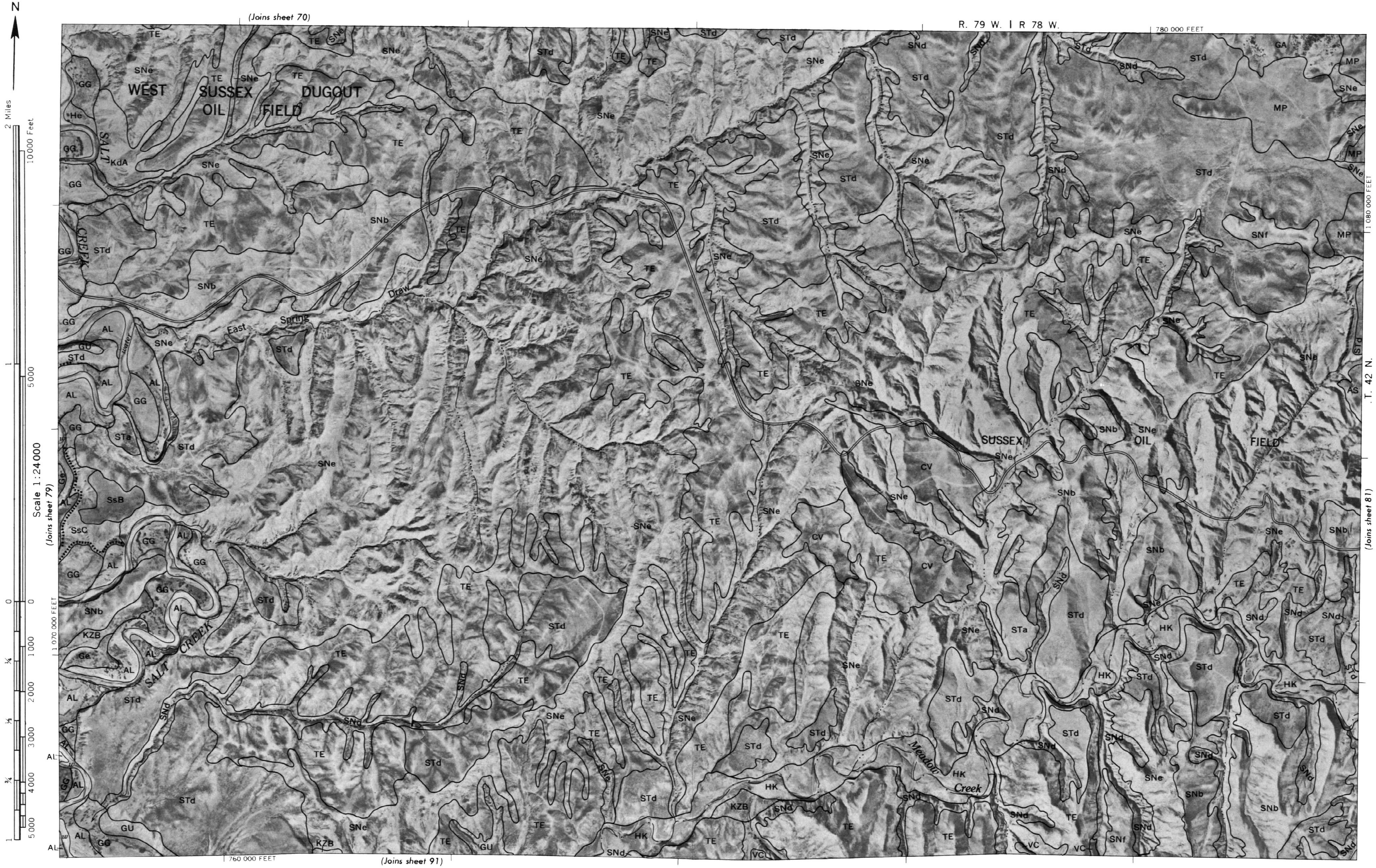
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



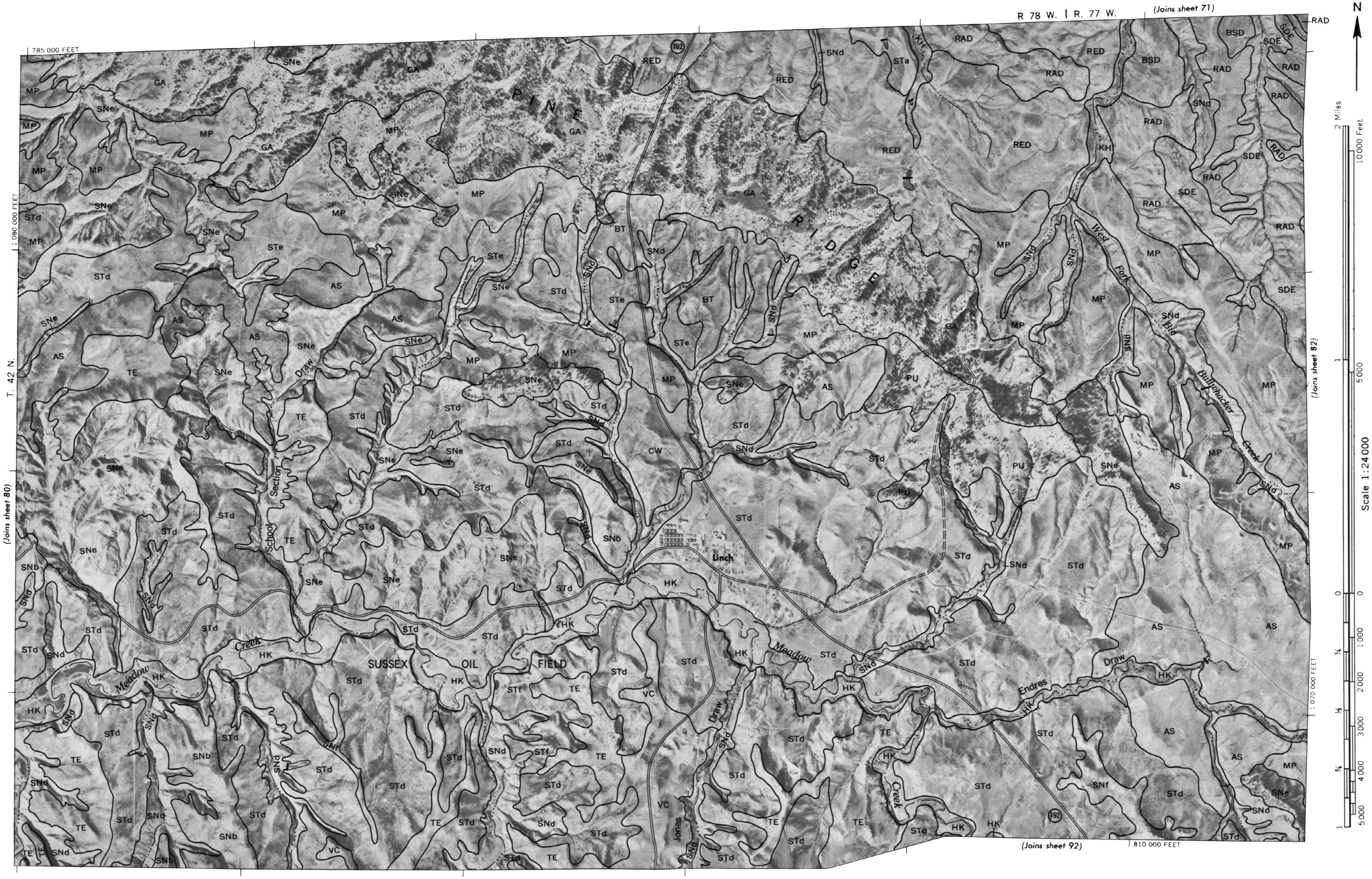
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



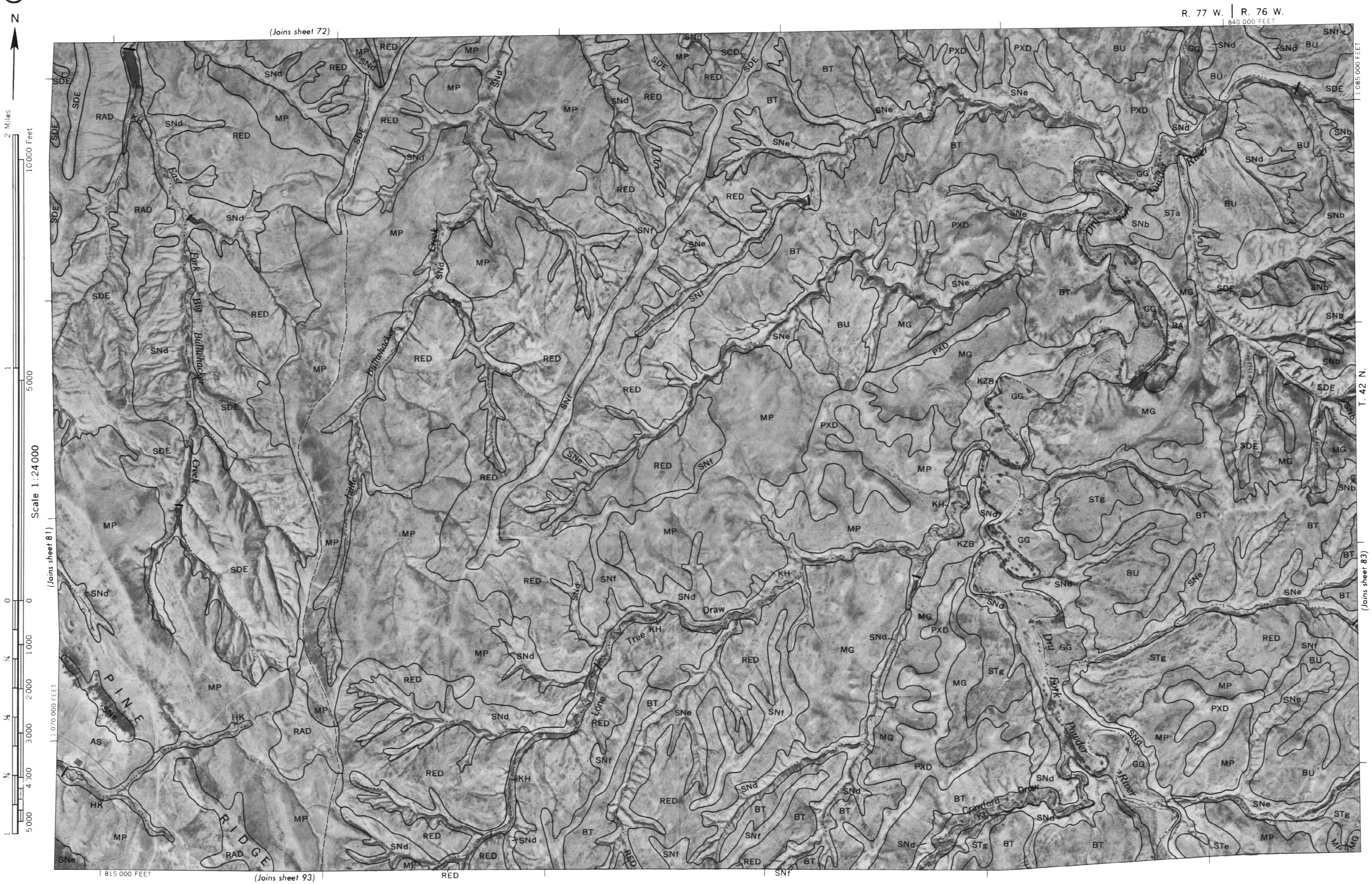
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



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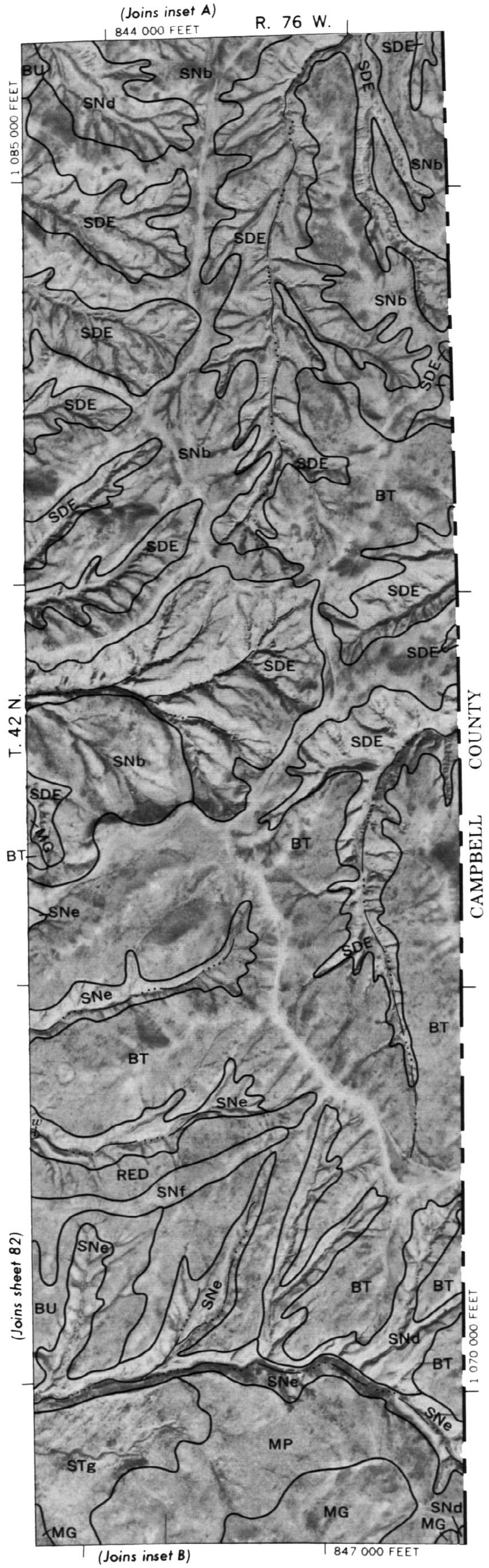
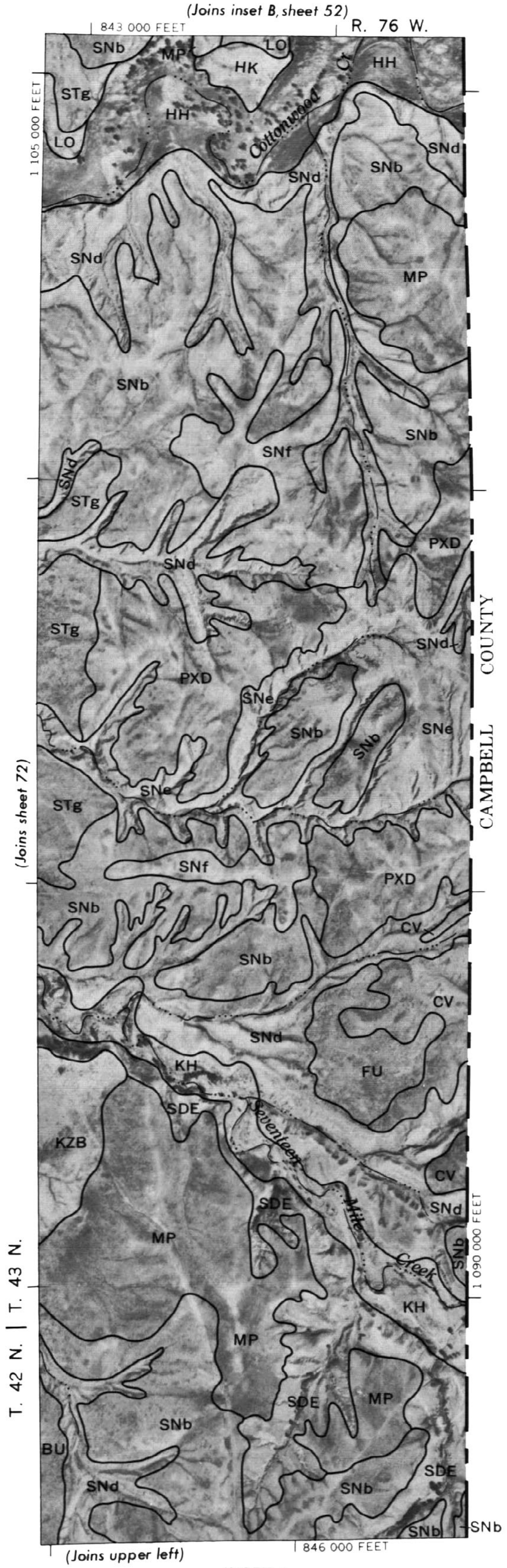
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

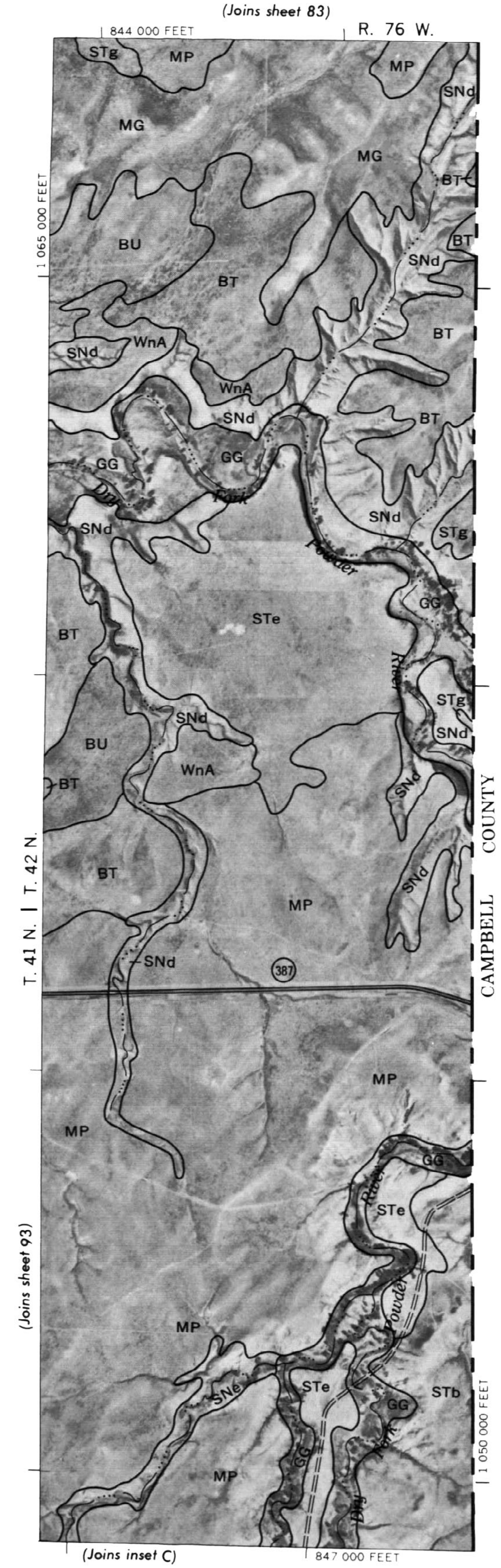


3000 AND 5000-FOOT GRID TICKS



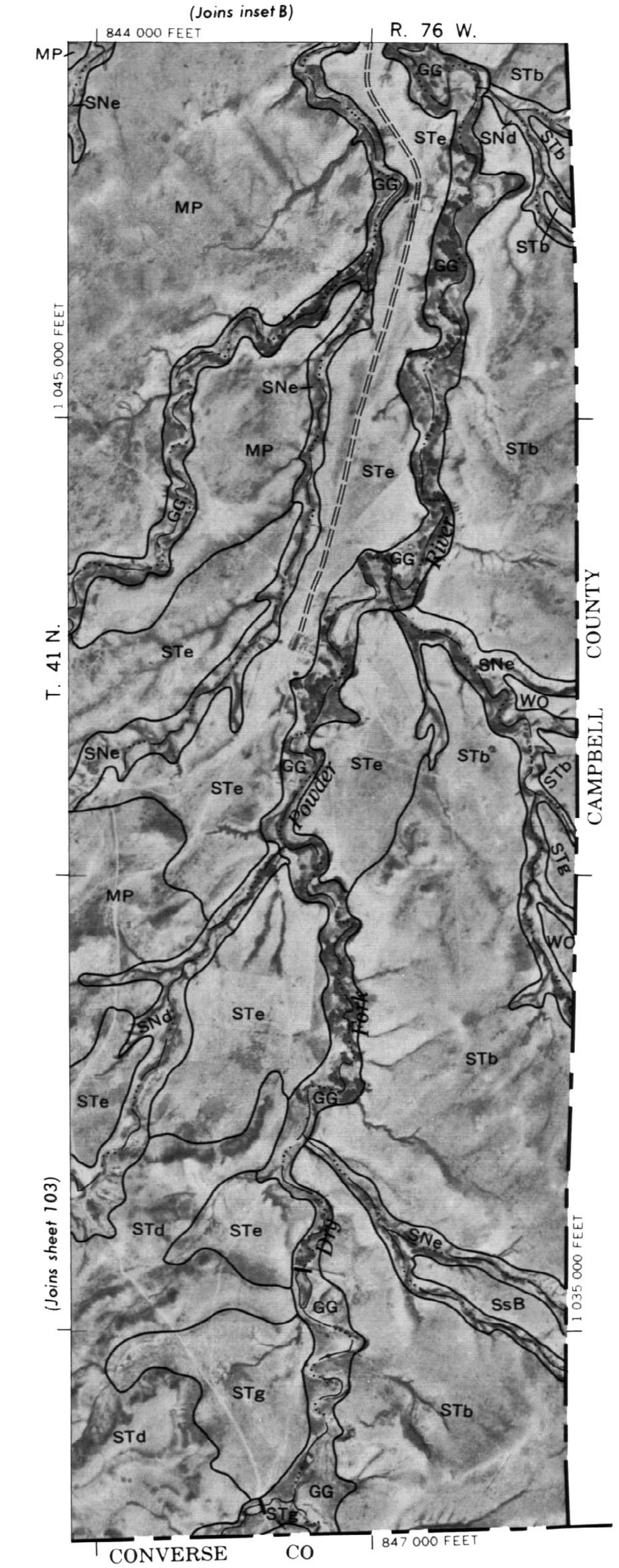
INSET A

3000 AND 5000-FOOT GRID TICKS



INSET B

3000 AND 5000-FOOT GRID TICKS



INSET C

3000 AND 5000-FOOT GRID TICKS

N

2 Miles
1
0
1/4
1/2
3/4
1
10000 Feet
5000
0
1000
2000
3000
4000
5000

Scale 1:24000

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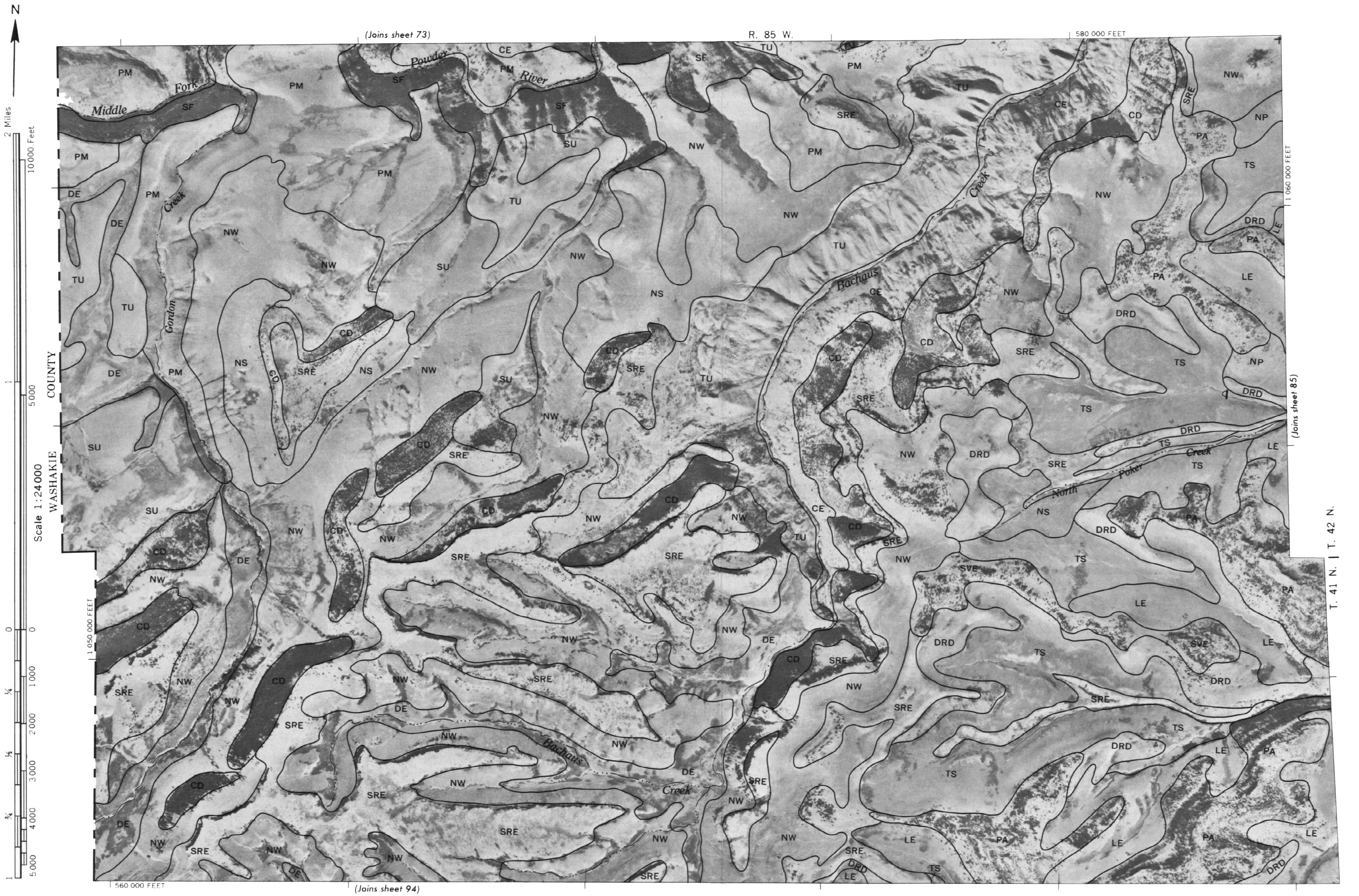
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



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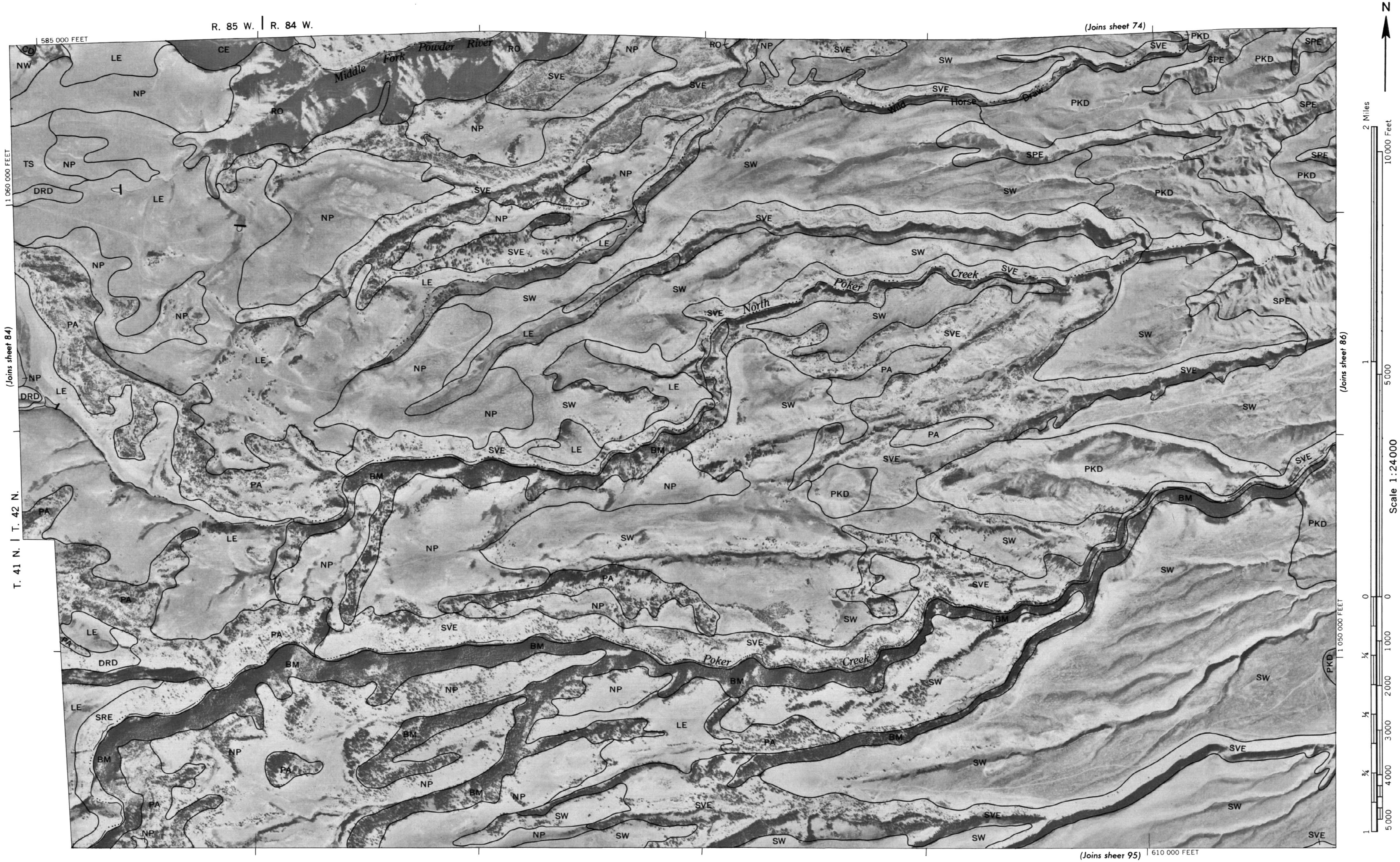
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



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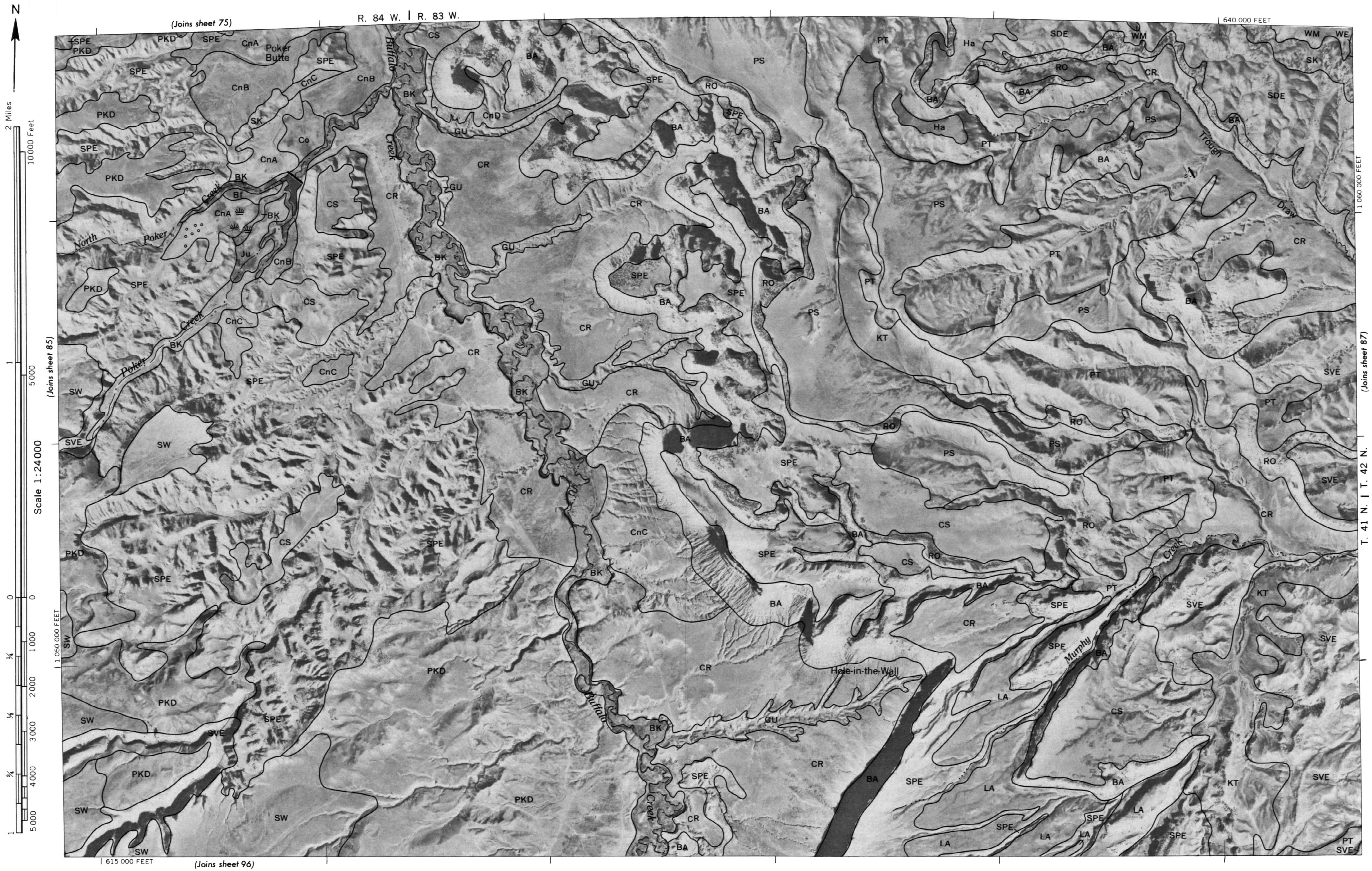
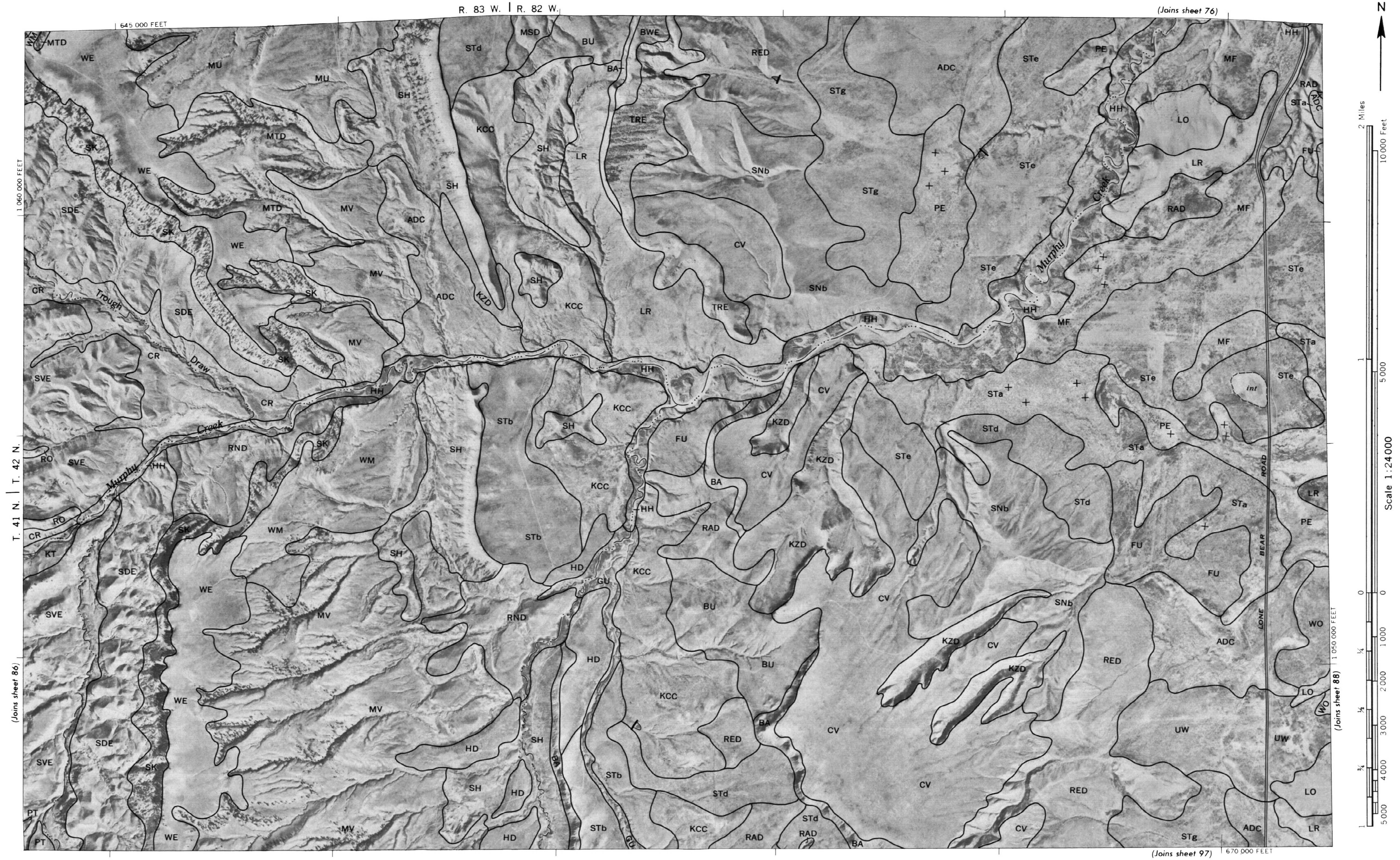
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 86



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 88

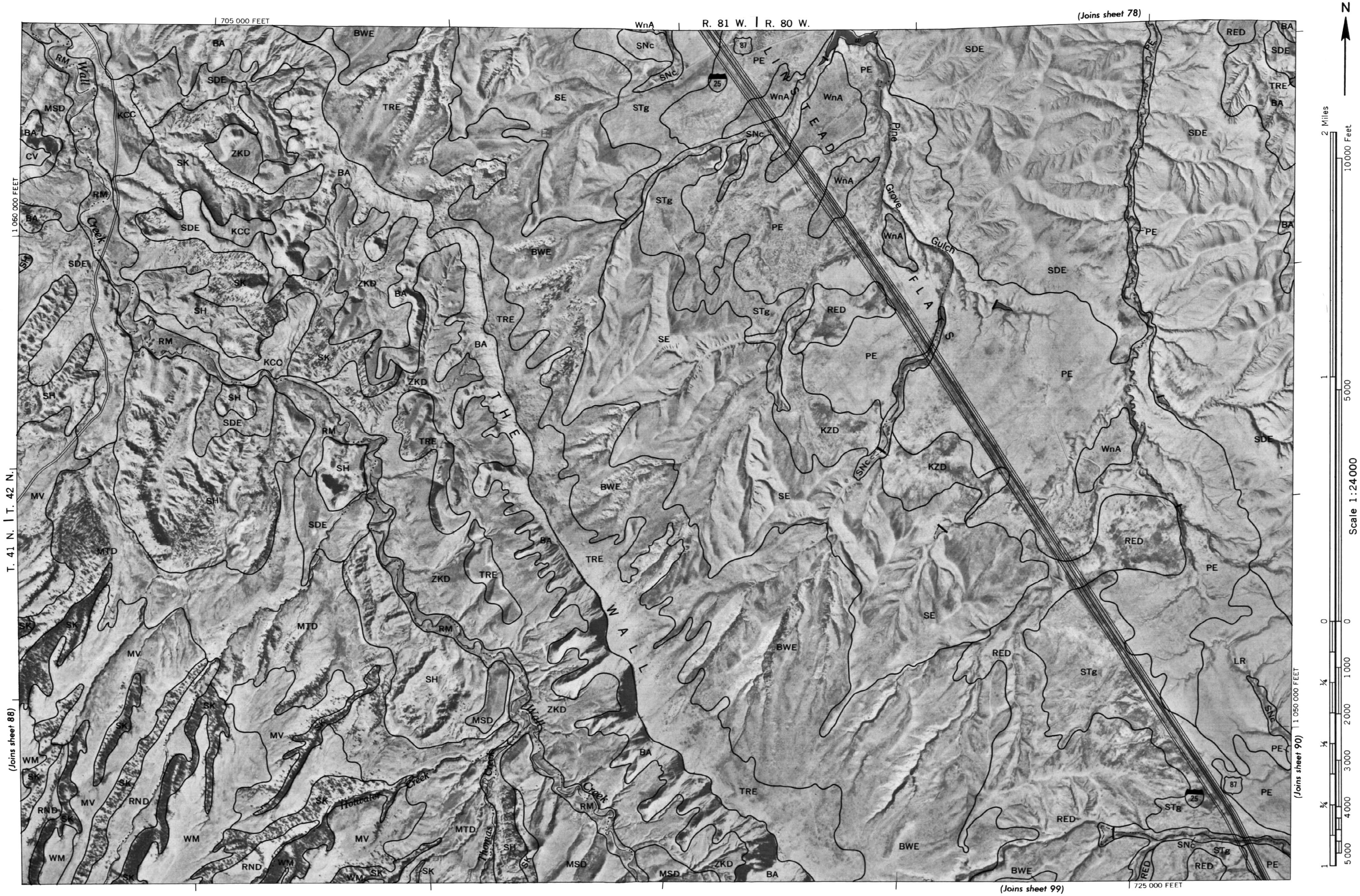
N

2 Miles — 10000 Feet — 1 — 5000 — 0 — 0 — 1000 — 2000 — 3000 — 4000 — 5000 — ¼ — ½ — ¾ — 1

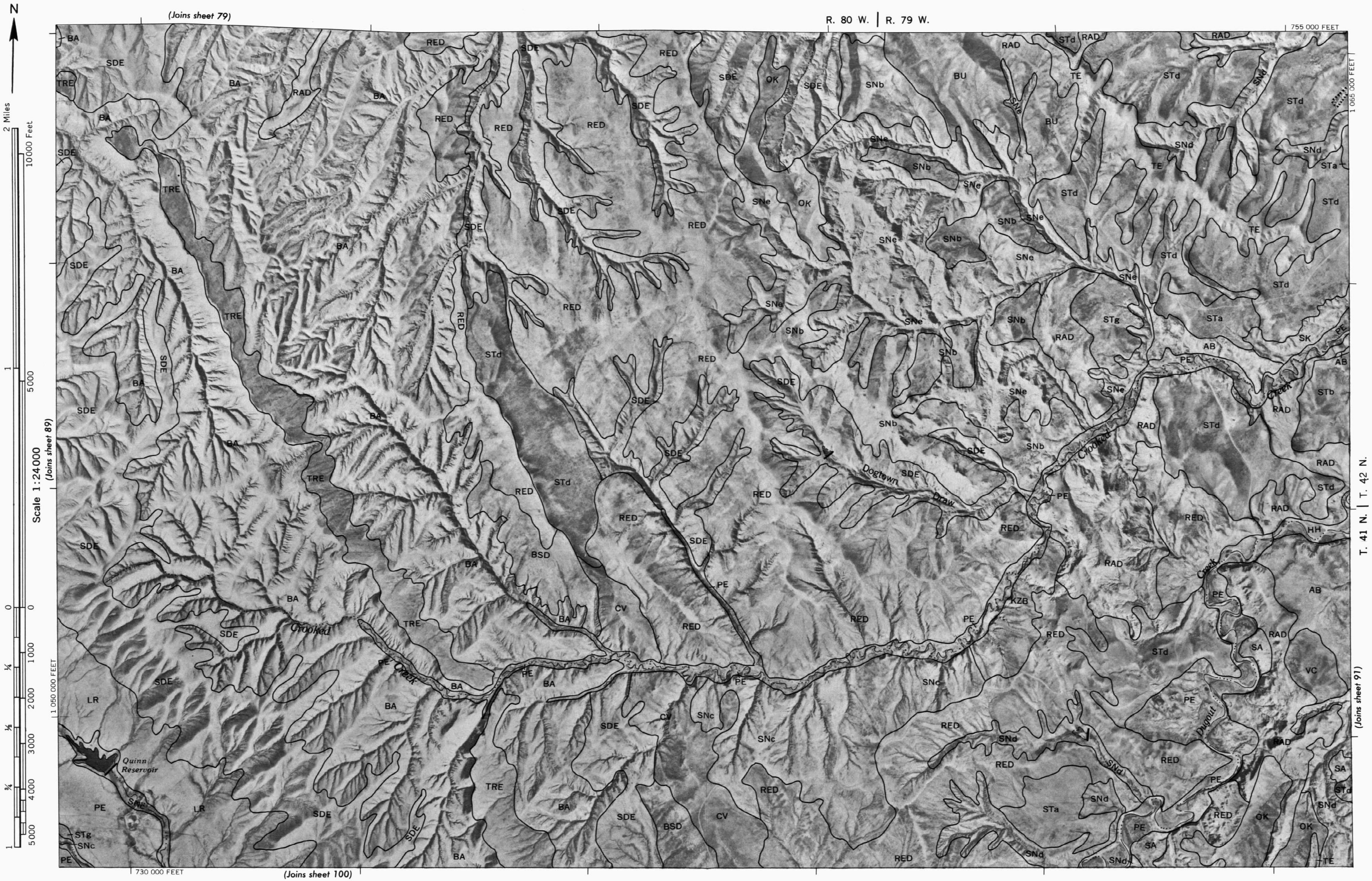
Scale 1:24000

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

89

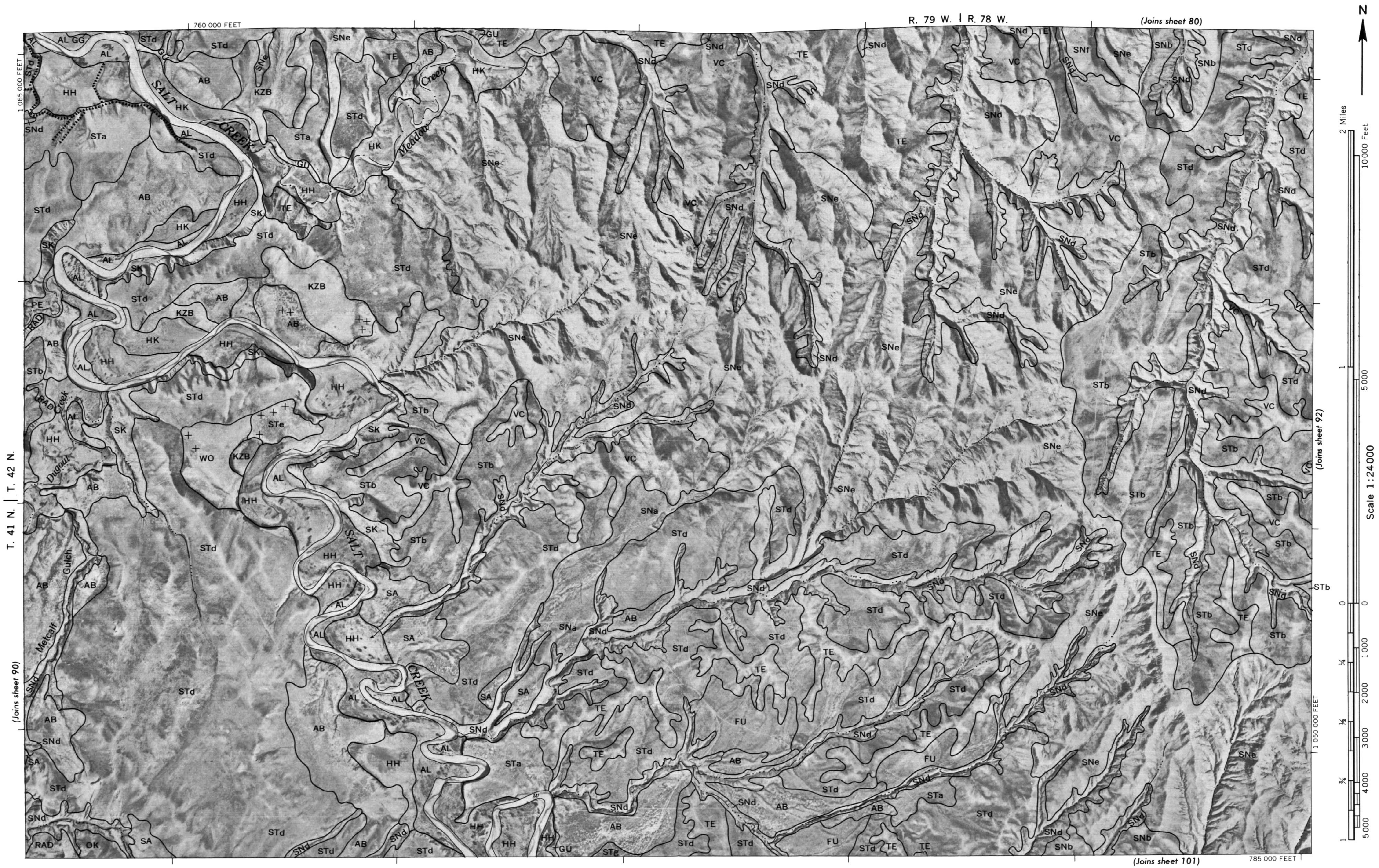


This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

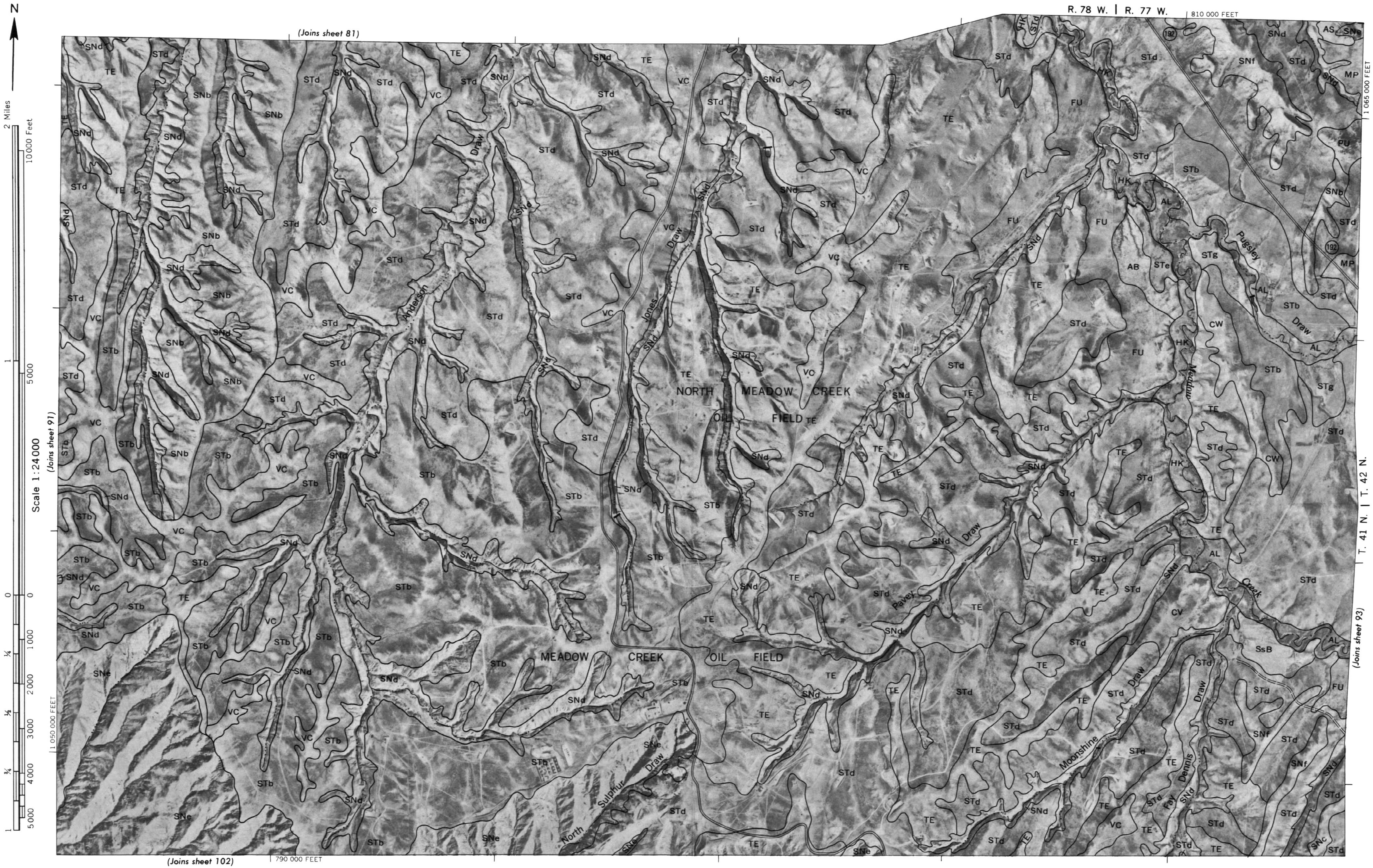
JOHNSON COUNTY, WYOMING - SOUTHERN PART NO. 90



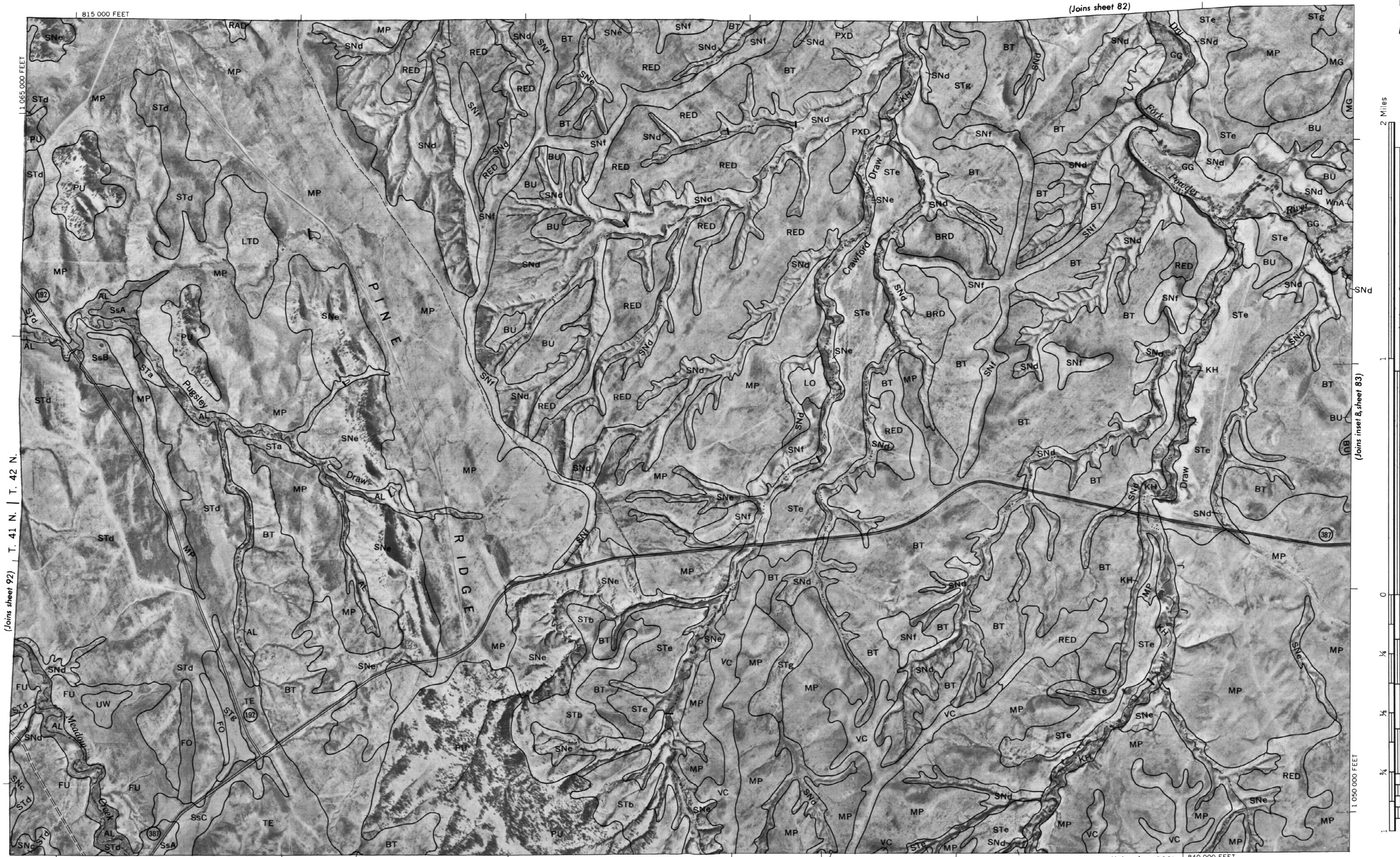
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.

Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 92

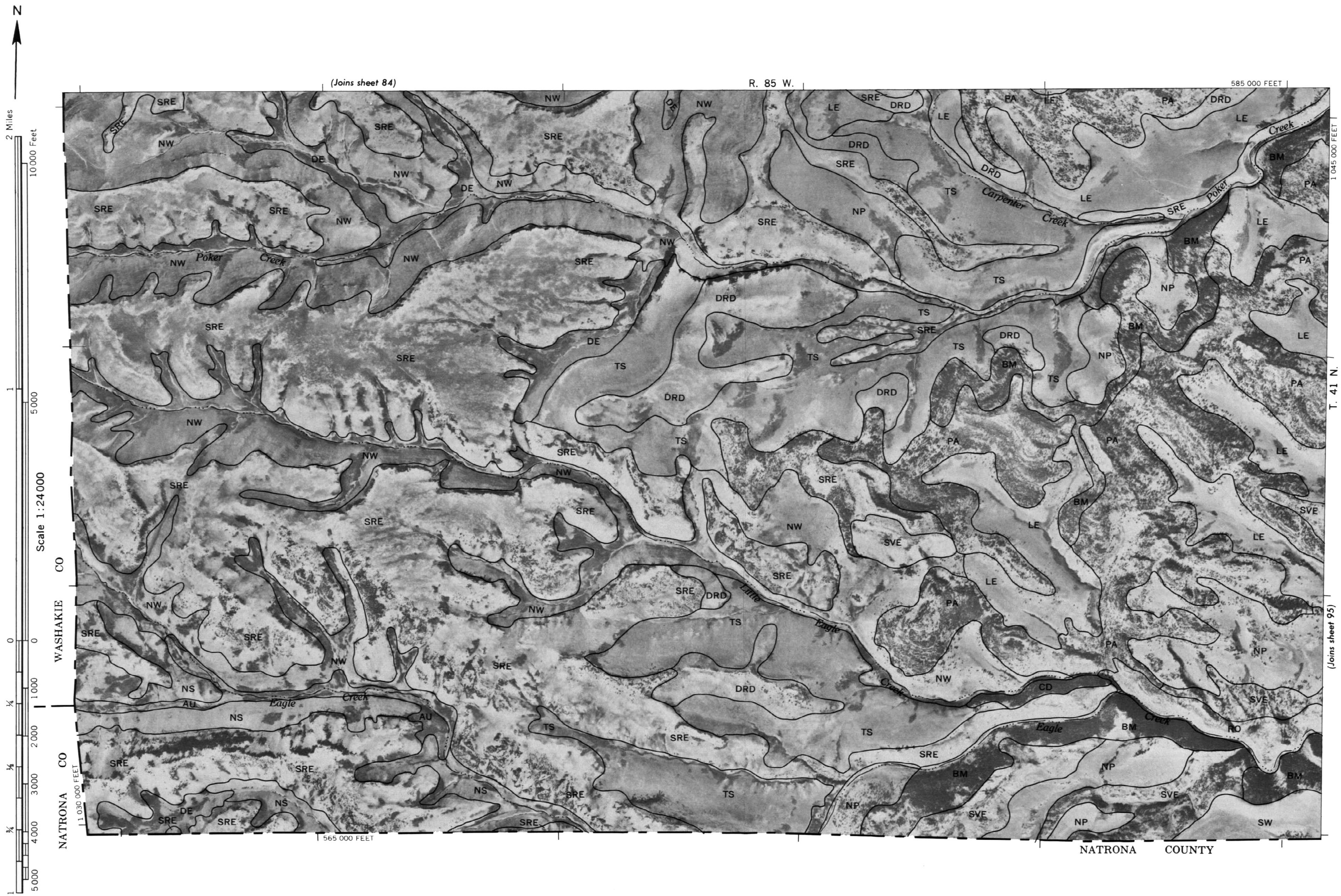


This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

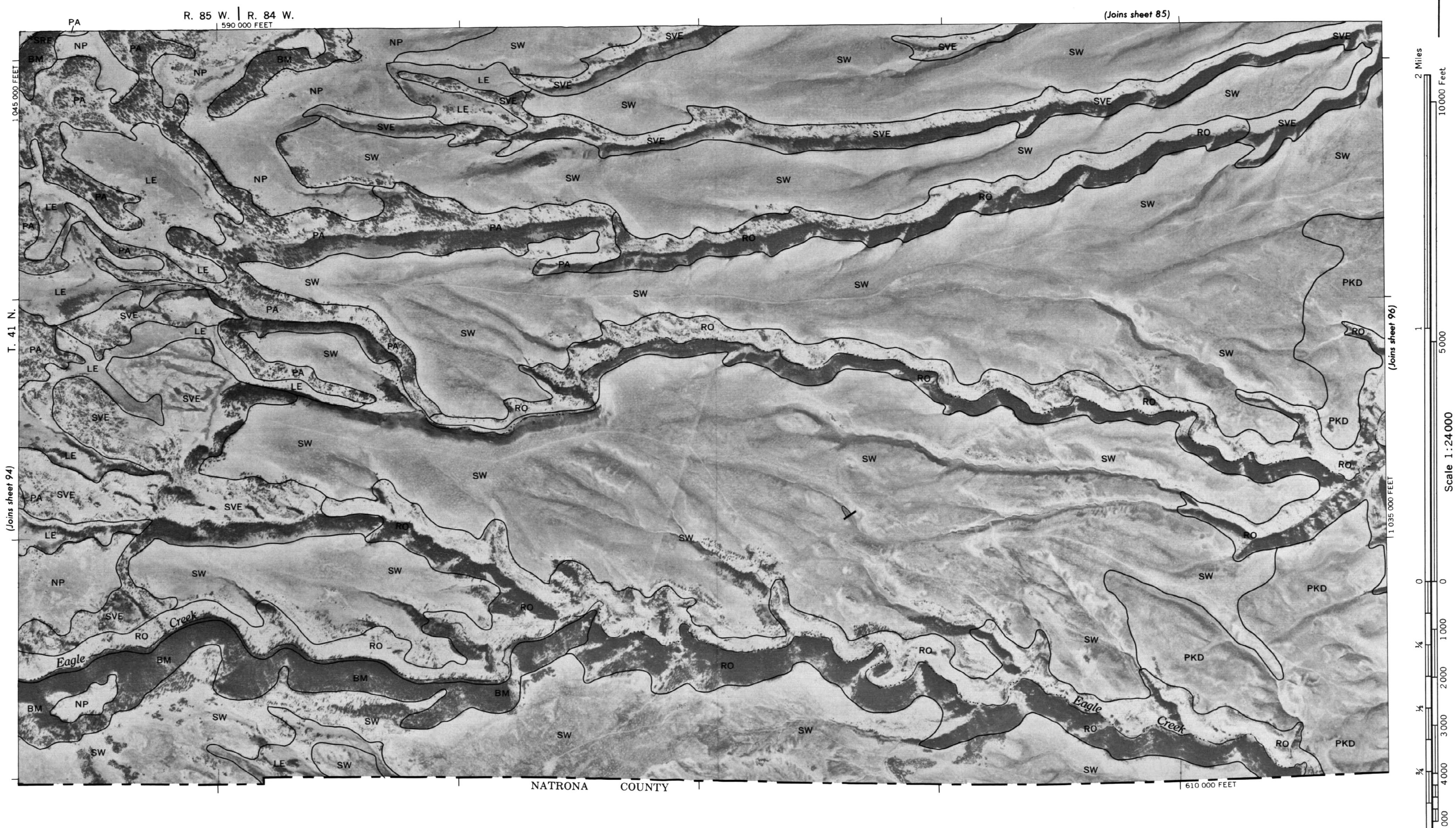


This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

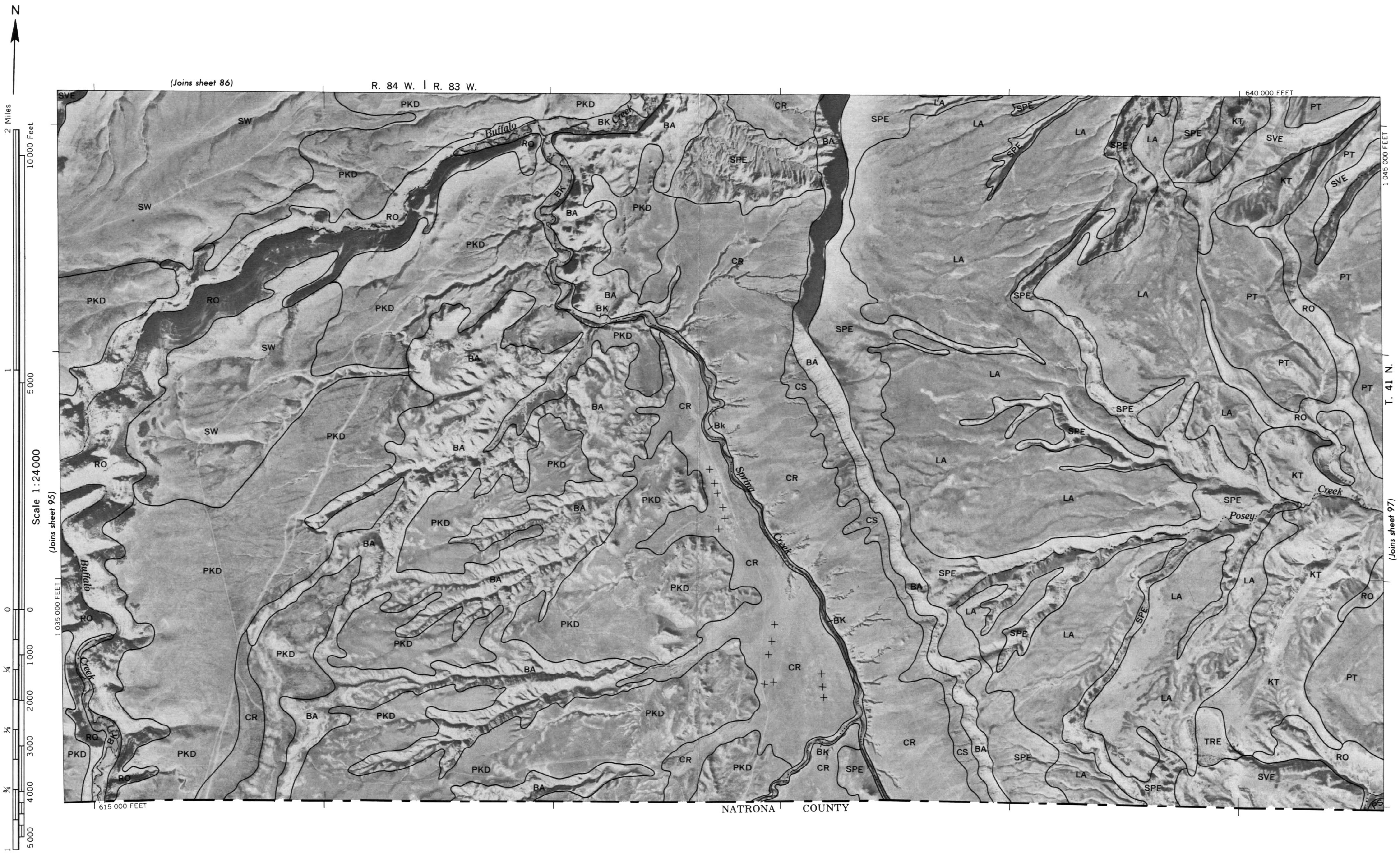
JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 94



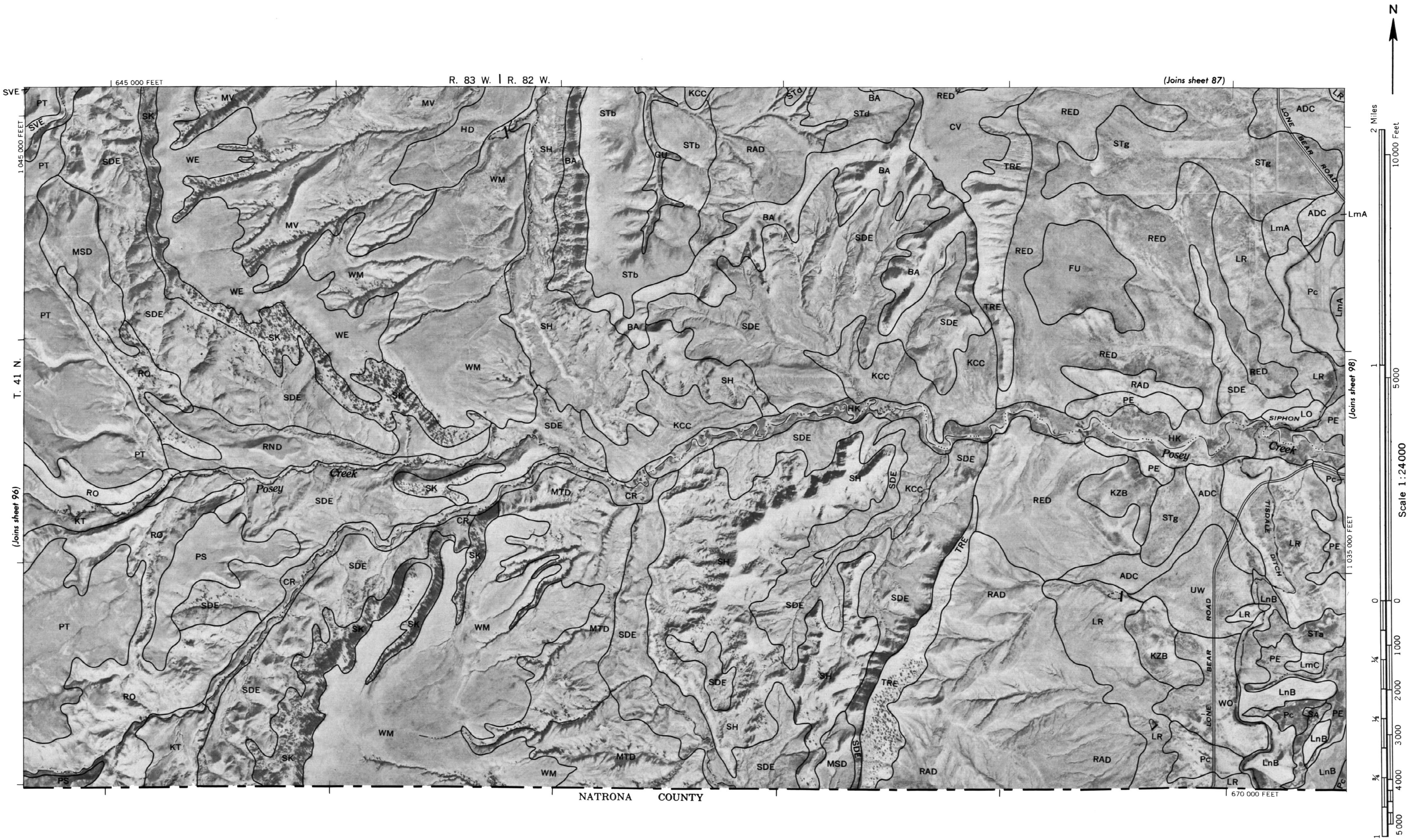
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

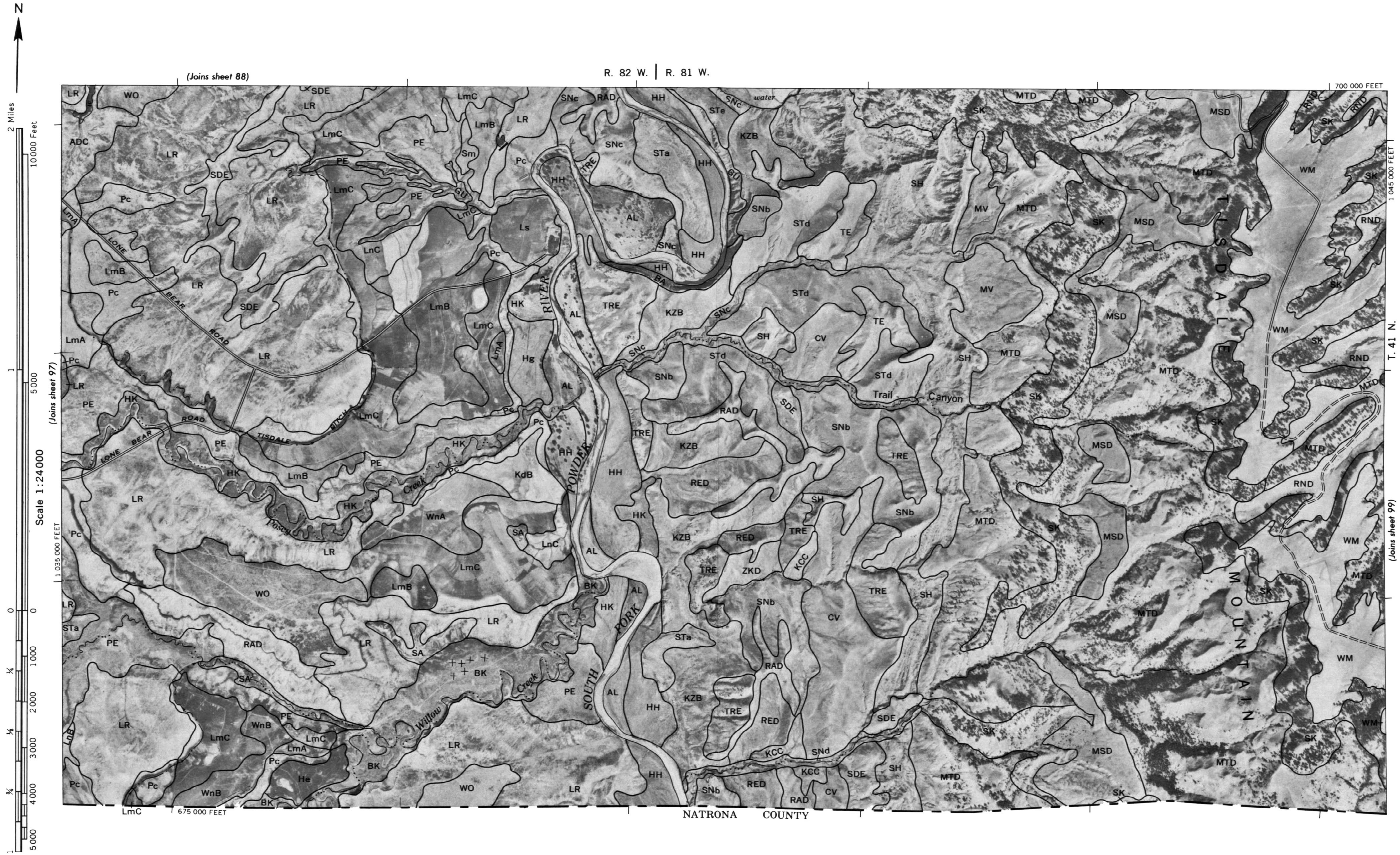


This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

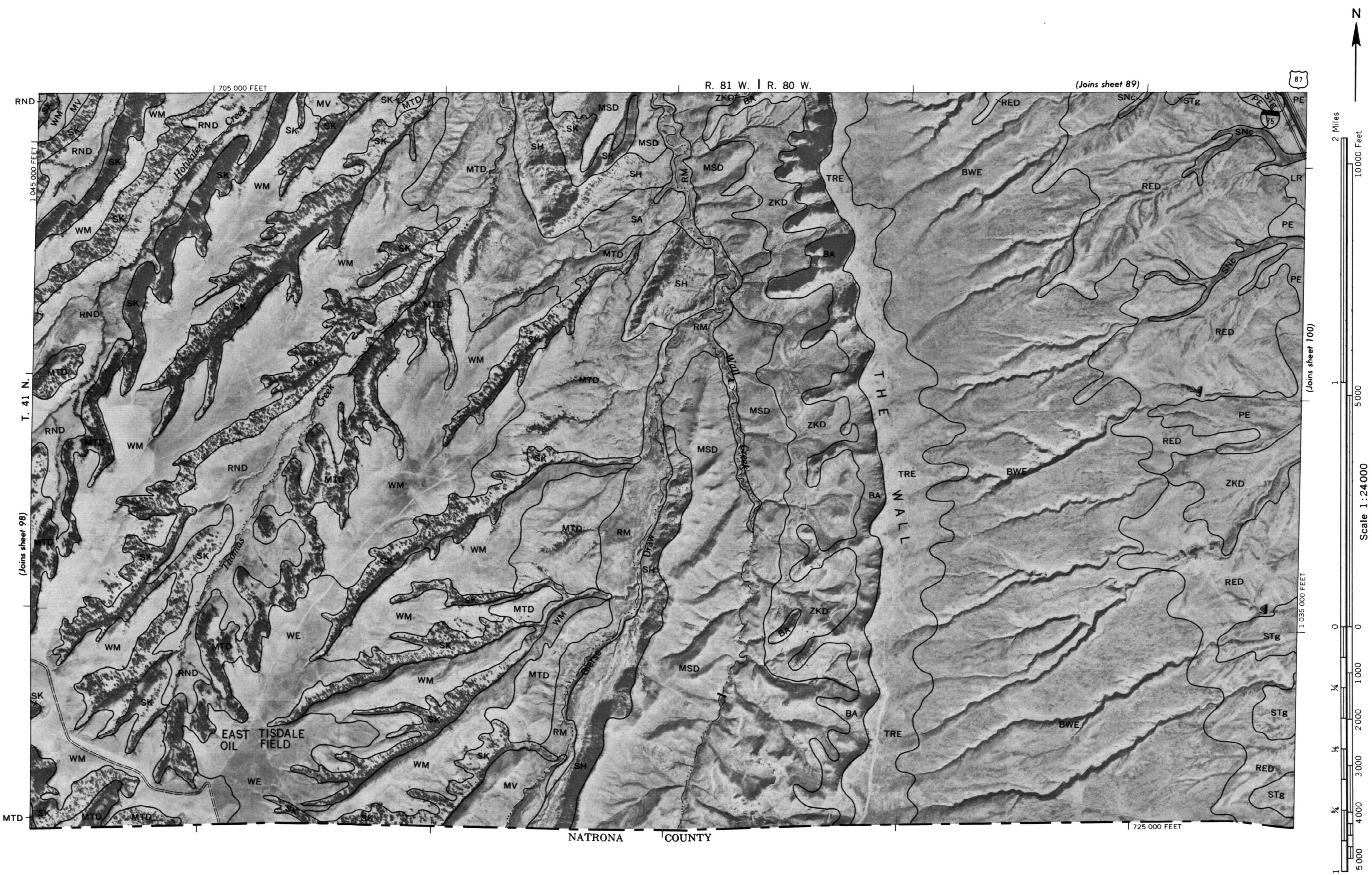


This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 98



This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



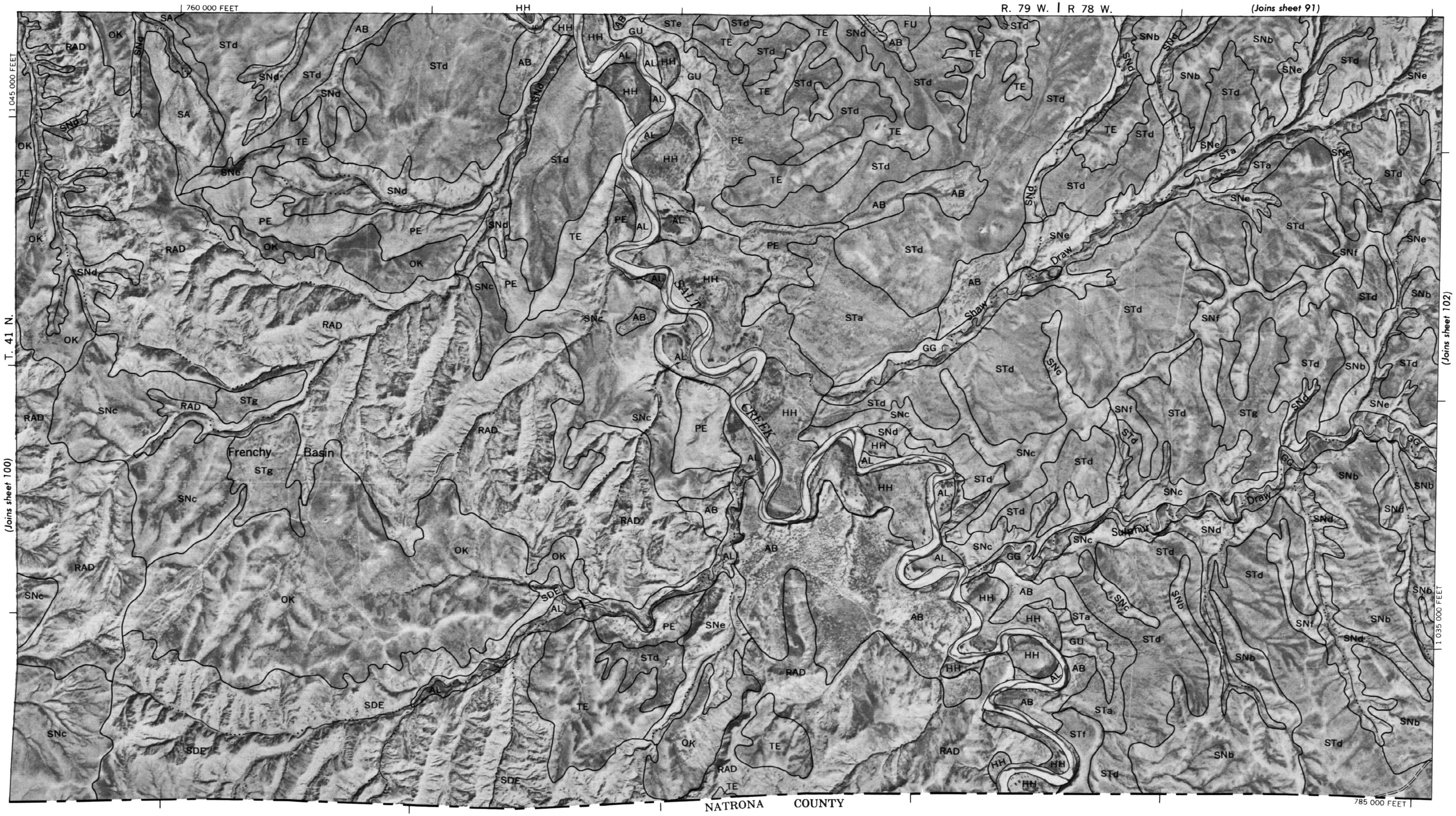
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

JOHNSON COUNTY, WYOMING — SOUTHERN PART — SHEET NUMBER 100

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

101

N



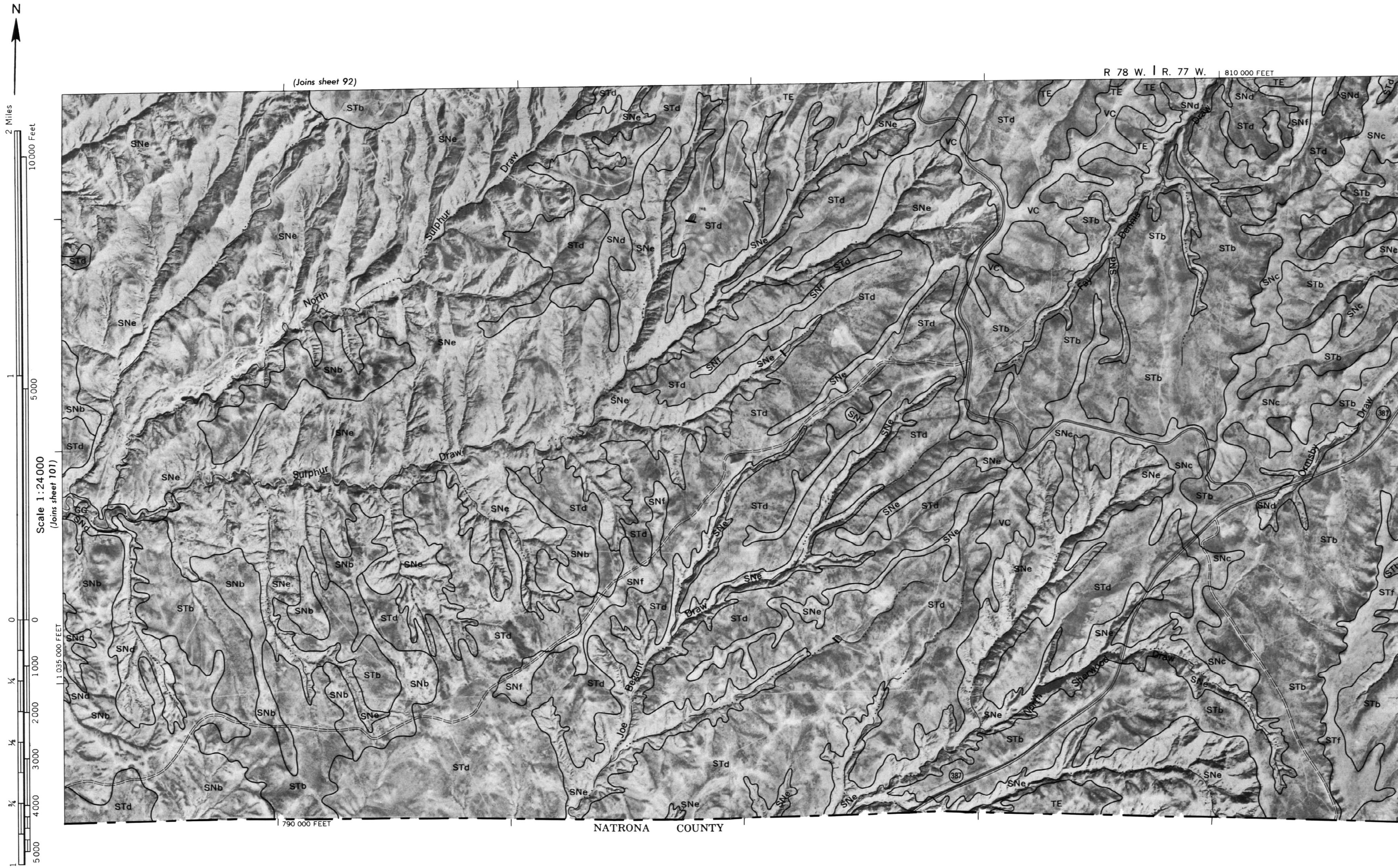
Scale 1:24000

2 Miles | 1 | 0

10000 Feet | 5000 | 0 | 1000 | 2000 | 3000 | 4000 | 5000

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.

Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.



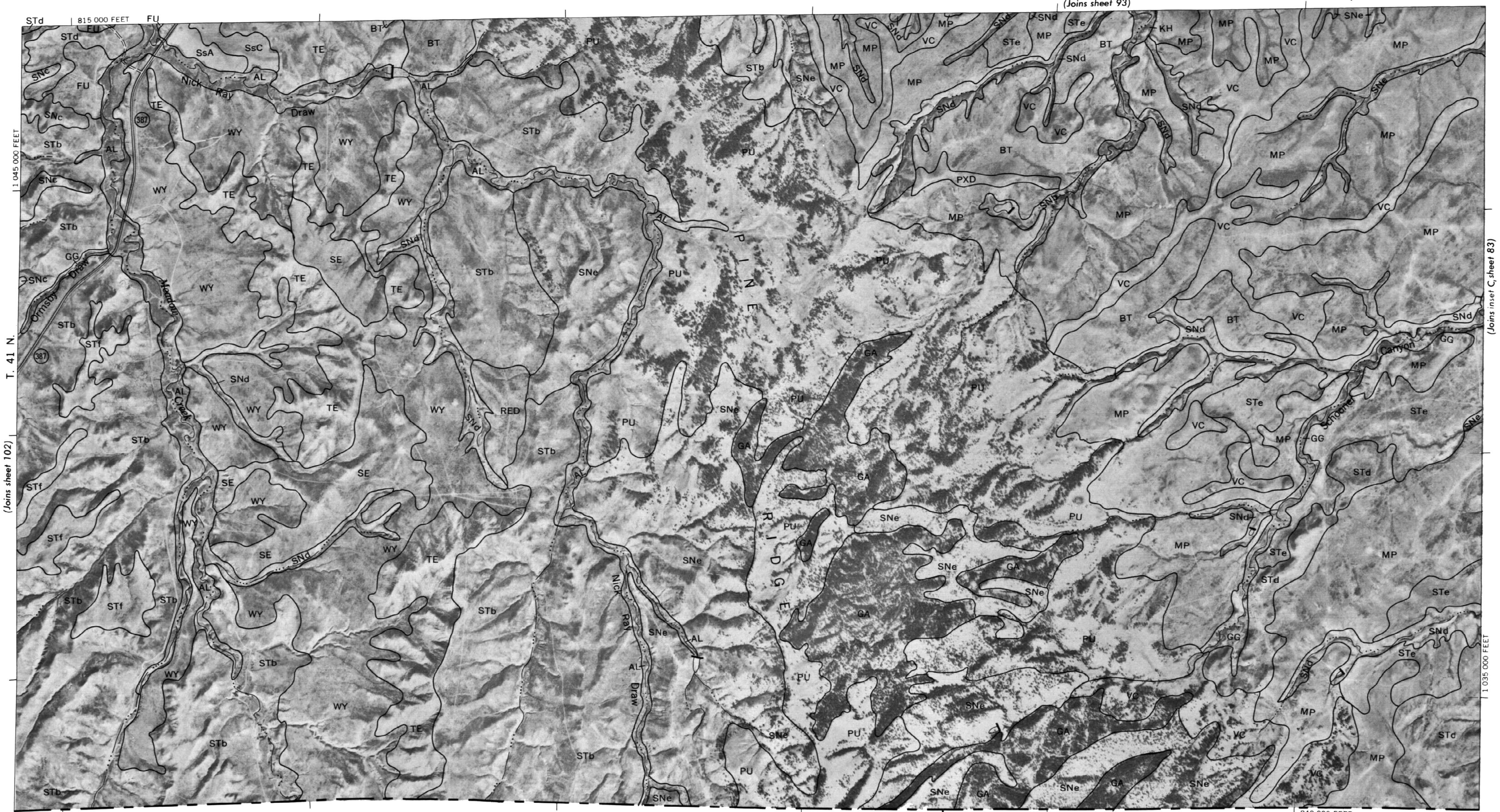
This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
Photobase from 1954 and 1968 aerial photography. Positions of 5,000-foot grid ticks are approximate and based on the Wyoming coordinate system, east central zone.

103

N

R. 77 W. | R. 76 W.

(Joins sheet 93)



NATRONA COUNTY | CONVERSE COUNTY

Scale 1:24 000

2 Miles | 1 | ¾ | ½ | ¼ | 0 | 1

10 000 Feet | 5000 | 0 | 1000 | 2000 | 3000 | 4000 | 5000

This map is one of a set compiled in 1973 as part of a soil survey by the United States Department of Agriculture, Soil Conservation Service, and the Wyoming Agricultural Experiment Station.
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